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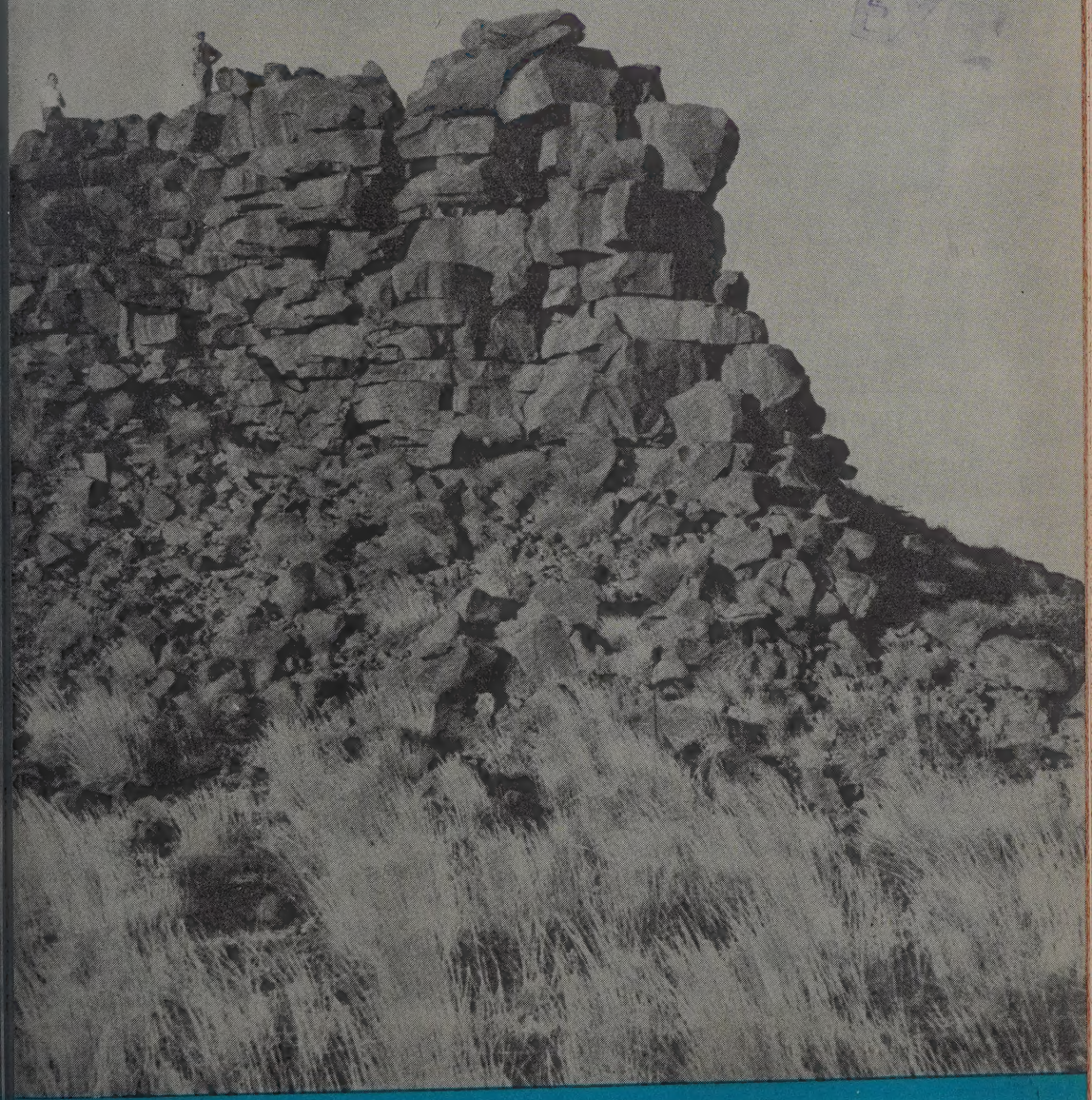

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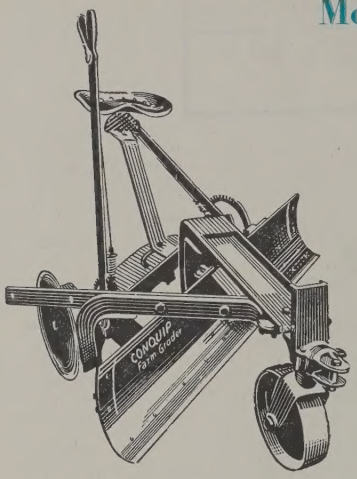

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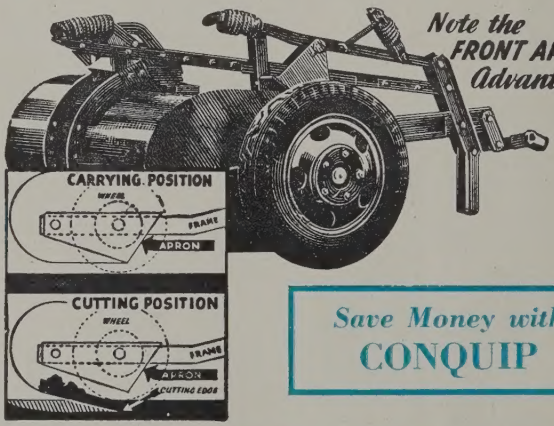

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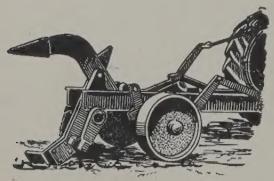

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J. A. MALLETT

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COVER PICTURE

This mighty rampart of huge rocks is one of many on Abydos Station in the Port Hedland hinterland. Millions of years ago a gigantic upsurge of the land mass occurred and this was followed by countless centuries of subsistence and erosion. These masses of ferruginous shale represent the less erodible portions of what were originally extensive rock formations

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The Preparation and Handling of Dairy Cattle for Shows

By FORREST ROSE

Fig. 1.—"If the animal has a good head, make sure that the judge can see it"

SUCCESS in the show ring is not easy to achieve. The blue ribbons do not always go to the animals which the owner knows to be good, and a little thought will show us why. In the first place, the owner's opinion of a beast is formed over a long period, probably since the animal was born. He knows all about its disposition and its performance on the home farm; how delightful it looked last spring and so forth. The judge who allots the prizes does so on opinions formed during the brief period that the animals are under his scrutiny in the judging ring.

The actions and appearance of an animal during that period may or may not be typical of its normal appearance and behaviour, but the judge is not clairvoyant and can only judge on what he sees at the time.

Obviously, it is up to the owner to educate and prepare the animals so that they can be depended upon to behave well and look well when they are under the judge's eye in the ring. Education is important, for without it many months of preparation can be wasted.

An early education is indicated and the procedure I have always adopted is to stable all calves for about three weeks when they are taken from the calf paddock to be weaned at the age of about seven months.

During the stabling period, each calf is haltered and tied up securely in a stall. It is led out for exercise each day and taught to lead properly. The aim at this stage of training is to teach the calf to step out freely and confidently, carrying its head well and generally looking as if it is enjoying itself.

Each time the calf is halted it should be taught to stand with its head up and all four legs planted squarely. A light

Mr. Forrest Rose has had a lifetime of experience in breeding, exhibiting and judging stud stock. He is the son of Mr. R. H. Rose, one of Australia's foremost Jersey cattle judges, and their "Grass Vale" Stud, Burekup, has long been famous for the quality of its Jerseys. The stud has been awarded the Governor's Cup at the Perth Royal Show on several occasions. This trophy is awarded to the most successful exhibitor in the livestock sections.

touch of a cane, or even of the trainer's boot, to any badly-placed foot will soon teach the calf to alter its stance, and it is surprising how quickly it will learn the lesson and stand well without prompting.

The trainer must have the full confidence of his pupil. This requires patience and kindness. Never attempt to hurry the training, and if you find yourself becoming irritable or impatient it is better to postpone the lesson until you are in a better mood.

I have often been asked, "Why do you go to the trouble of educating **all** the stud calves when you will only be showing the best? Why not pick out the best and concentrate on them?

My answer to that is that once a calf is educated at an early age, it will remember the training throughout its life. From my own experience, I know that a rather plain-looking calf can often develop into a first-class show animal and, if it has not been educated as a youngster, it will be difficult to train later in life. I once tried to educate a mature cow for the show-ring but the task proved hopeless and the cow was never shown.

A well-educated animal will enjoy being paraded round the judging ring. It will have confidence in its attendant and will have no fear of crowds or noises so long as he is by its side.

Compare this with some of the animals one sees being dragged round the ring, afraid of the leader, the crowds and everything else.

Fig. 2.—An excellent mature Jersey udder

Fig. 3.—A poorly-attached and pendulous udder

FEEDING

Dairy cattle for showing should be well-fed to give them bloom, but should not be over-conditioned—this applies particularly to bulls and dry stock. One of the best, cheapest, and most readily available foods to put bloom on a bull or a yearling heifer is separated milk given with a ration of concentrates, chaff and hay and grazing.

The quantity of separated milk to feed will depend on the condition of the animal when you commence to prepare it for the show—which should be at least eight weeks before the event.

DON'T make the mistake of changing to whole milk at the show—it will only upset the animal's digestion. It would be better to give a cup of whole milk in a gallon of water.

It is a good plan to feed your cattle—for a few days prior to leaving for the show—on a ration which is as near as possible to that which they will receive while at the showground. They will travel better on hard feed, and settle down more readily.

The secret of successful feeding is to feed little and often—**and never to put fresh feed on top of old.**

If you want to save on feed bills, keep the feed-boxes filled. You'll save on feed costs but your cattle will suffer. I have seen cattle leave their stalls after a week at the showground with their feed-boxes full of mouldy chaff. No wonder some herdsmen complain that their cows are nearly dry by the end of the show.

A point worth remembering, incidentally, is that cattle will always drink better at night when the showground is reasonably quiet.

CLIPPING AND RUGGING

The bodies and legs of the cattle should be clipped about six weeks prior to the show, and the animals rugged with heavy rugs which should only be removed on warm days. I refer, of course, to preparation for a spring show. Heads, necks and tails may be clipped within a week of the show.

The early clipping of the bodies is advisable because, when newly-clipped, an attractive bronze or golden colour can appear drab and mousy. The original colour returns about four to six weeks after clipping.

If you have no factory-made rugs, six cornsacks sewn together will make a serviceable substitute.

The invention of the rubber currycomb has reduced the time spent on grooming, but it is still necessary to finish this important task with a soft hair brush.

HORNS

Every breeder should have in his mind's eye, the ideal shape that the horns should be. Some preliminary training and a certain amount of shaping with a rasp will bring them close to the ideal. Care must be taken not to rasp off too much horn and thus cause bleeding. Horns should usually be tipped, so that the points are blunted sufficiently to lessen the risk of injuries to other animals—or the clothes and person of the herdsmen if the animal is in playful mood.

Once the horns are shaped and deep scratches removed with the rasp, use coarse carborundum tape, glass, or a scraper. Follow this with fine carborundum tape, bath-cleaning paste or cement and a wet chamois leather to further smooth the surface. Finish with a light polishing oil prior to judging.

To protect polished horns, sew two pieces of bagging over them and draw the coverings together by a few stitches between the horns, using a sack needle.

WASHING

It is a good plan to wash the cattle all over before leaving for the show—the weather may be unfavourable on arrival at the showground. A good practice is to take the animals to the wash-stand each morning before breakfast and after milking. Sponge the heads and eyes and clean the ears, hooves and hindquarters.

Tails should be washed and combed out then plaited tightly while wet at least 12 hours before judging. They should be combed out when perfectly dry. Flour bags are handy for covering tails once they have been plaited.

BEDDING

Keeping your animals well bedded down adds to their comfort and contentment. By working the soiled straw to the bottom of the animal's bed and adding fresh straw to the top, a deep firm bed can be made which, apart from the saving in straw has the effect of elevating the cattle and enhancing their appearance in the stalls.

RINGCRAFT

I consider this an important phase of showing stock. Having prepared and educated your animals to the best of your ability, see that you yourself and the other attendants are equally well turned out, clean, neatly dressed and white-coated.

The headstalls on the animals should be clean, neat and well-fitting. Decide on a certain pattern of headstall and have them all made to the same pattern but in sizes to fit different animals. Halter-ropes should be clean and white.

Always make an early start on judging mornings and have your cattle ready to enter the ring on time.

From the time you enter the ring until you leave it, remember that your job is to display the animal you are leading to the best of your ability. There are only two things to concentrate on—the judge's eye and the animal you are leading.

This is not the time to exchange greetings with an old friend outside the ring—even if you haven't seen him for years. There will be plenty of time for a yarn later.

Don't try to do the judge's job for him, but always keep your eye on him and be ready to impress him with your animal's good points.

For instance, if your beast has a particularly attractive head, have it inclined towards the judge so that every time he looks your way he can be sure of seeing it.

Never give up trying until the ribbons are put on, whether you are at the top of the line or down at the bottom.

In conclusion, don't relax after judging. A good herdsman should have his cattle looking just as well on the last day of the show as they looked on the first day.

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TACKLING THE PROBLEMS OF THE SPINIFEX AREAS

North-West Field Day Strikes A New Note

By J. A. MALLETT

TO one who is almost in the "veteran" class as a field day visitor, there is a certain sameness about agricultural field days which is perhaps unavoidable. It was a refreshing change therefore to wing my way some 800 miles northward recently to attend a field day of a type that is probably unique in Australia.

It was a pastoral field day held in the spinifex areas of our North-West—at Abydos Station about 100 miles inland from Port Hedland to be more precise—and it was a gathering with an atmosphere all its own.

Instead of neatly-defined paddocks and pasture plots, a sea of sage-green spinifex topped by waving yellow seed-heads extended to the horizon, broken here and there by quaint rock formations and ranges of hump-backed hills.

Instead of the sleek sedans that accent the affluence of present-day farmers, there were trail-battered trucks, jeeps and Land Rovers that had bucked their way to Abydos over anything up to 200 miles of spine-jarring tracks.

In this land where the "next door neighbour" might be anything from 40 to 80 miles away many of the station men had spent a night on the track en route to the field day. When the day's activities were ended they unrolled their "swags" in the Abydos shearing shed and snatched a few hours' sleep before taking the trail again at first light on the following morning.

There was a cheery informality about the whole show—a light-hearted picnic atmosphere with old friends swapping the latest news and a vigorous giving and taking of good-humoured raillery—yet beneath it all was the keen interest which had brought these men many miles to learn more about matters which deeply concerned them.

A specially-chartered aircraft had touched down on the station airstrip on the previous day, having flown from Perth, over 800 miles to the southward. It carried five prominent members of the Pastoralists' Association of Western Australia (Inc.)—the president (Mr. R. F. Adamson), the secretary (Mr. H. R. C. Adkins), and Messrs. F. J. Robinson, E. H. B. Lefroy and P. B. Lefroy—as well as the Deputy-Director of Agriculture (Mr. I. Thomas), the Commissioner for Soil Conservation (Mr. G. H. Burvill) and the author.

Other visitors to the field day included Professor W. S. Phillips, Professor of Botany at the University of Arizona—who is at present in Australia as a Fullbright Fellowship appointee—and a Senior Agrostologist of the Queensland Department of Agriculture and Stock (Mr. S. Marriott).

Fig. 1.—Abydos Station homestead. The rounded, eave-less roof and the heavy verandah shutters help to protect the building against cyclone damage.

A DEPRESSING RECORD

Some indication of the seriousness of the problem of declining carrying capacity in the spinifex zone may be gathered from the record of the Abydos and Woodstock properties, two adjoining stations of 387, 794 and 267,486 acres respectively.

Sheep numbers in 1933 were given as 33,037 and 4,900 lambs. Five years later the corresponding figures were 24,071 and 506. By 1942 the tallies had dropped to 9,821 sheep. The 1944 figures were 7,219 sheep and the properties were abandoned in the following year.

The decline is not confined to these two stations, but is typical—to a greater or lesser degree—of a general decline which took place over a large portion of the spinifex country during that period.

In 1946 Abydos and Woodstock Stations were purchased by the State Government to serve as a research centre at which local problems could be studied with a view to inaugurating remedial measures.

It was obvious from the beginning that many factors had contributed to the decline. Drought years, cyclone damage and hordes of kangaroos—mainly the euros or "hill kangaroos"— had all played their part.

Nearer the coast, a serious soil erosion problem had arisen. In some places the soil had been bared to such an extent that the topsoil had blown away, leaving vast "claypans" up to 25 square miles in area. Rain falling on these bare expanses had evaporated leaving a deposit of salt which added to the difficulties of reclamation.

RESEARCH PROJECTS

Agricultural Adviser, Hank Suijdendorp who has been in charge of the research work in this area, has outlined the history of the decline in previous articles in the "Journal."

Briefly, the facts are that in the early utilisation of the spinifex areas the sheep were shepherded in the vicinity of surface waters. As these areas became eaten out, it was the practice to fence new areas of country in which wells were sunk and equipped with windmills and troughs.

These new areas provided good feed for the ewes, as in addition to the more palatable and nutritious "soft" spinifex species they carried perennial grasses and edible shrubs. Lambing percentages were high on this type of country and the flocks increased in strength.

Fig. 2.—Visitors inspecting one of the experimental paddocks.

Unfortunately, the establishment of watering-points in areas which were normally dry for much of the year, led to a tremendous increase in the kangaroo population and these pests soon outnumbered the sheep.

From about 1920 onward, suitable virgin country became scarce, and the fenced areas, subjected to heavy grazing by sheep and kangaroos began to deteriorate.

The palatable and nutritious perennial plants were not only prevented from seeding, but were eaten down to such an extent that their root reserves were exhausted and the plants died.

Freed from competition, the unpalatable and innutritious plants multiplied rapidly. Paddocks which once carried ample feed for breeding ewes now barely provide a maintenance ration.

PLANT INTRODUCTION

Replacing the eaten-out plants with others equally nutritious seemed the logical answer to the problem and Buffel grass (*Cenchrus ciliaris* L.) and Birdwood grass (*Cenchrus setigerns* Vahl.) have been introduced into many of the pastoral areas with marked success.

Fig. 3.—Great interest was shown in the growth of native grasses in the management trial. Plants which had not been seen in the area for ten years were re-appearing and multiplying in the experimental paddocks.

Fig. 4.—In the top picture taken just outside the fence in the 12-acre Continuous v. Deferred Grazing Trial, the effects of continuous grazing by kangaroos may be seen. Note the severely eaten-down butts of Curly Spinifex *(Plechtrachne spp.)* and Woollybutt grass *(Eragrostis eriopoda)*.

Below is a picture taken inside the fence showing the development of perennial grasses *(Eragrostis eriopoda* and *Eriachne sulcata)*. This plot has carried a sheep to three acres for two years on a rotational system permitting sectional deferment of grazing.

Fig. 5.—A corner of the 8-acre Management Trial. Curly Spinifex is well-represented inside the enclosure (left) but not outside.

Unfortunately these grasses require soils that are more fertile than much of the spinifex plain, although they do well on the alluvial soils bordering the watercourses.

A perennial plant known as kapok bush *(Aerua tomentosa)* which appears to have been accidentally introduced into the North-West, seems to hold definite promise.

The small black seeds of this plant are embedded in fluffy white balls of a kapok-like substance which appears to have been used as a filling for mattresses and pillows by the crews of pearling luggers, and more recently by Australian aboriginals. The plant is indigenous to Java, Sumatra and other islands north of Australia. It also grows in India and Afghanistan so could possibly have been introduced in camel fodder or the packing of camel-saddles.

The crude protein content of kapok bush foliage is as high as 26 per cent. and the plant is apparently relished by both sheep and cattle.

The seeds are hard, and difficult to germinate but work on the best methods of establishment is in progress. To date, the best results have been achieved by dropping the seeds into spinifex clumps which are later burnt.

ACCENT ON MANAGEMENT

With plant introduction work limited by the low fertility of much of the soil—deficiencies in nitrogen, phosphorus and potash are common—the best chance of successful rehabilitation appeared to be in bringing back the plants which had been eaten out in the past years.

Over many centuries, these had been evolved by natural selection so that they were well fitted for survival in this particular environment, and a series of management trials were instituted to ascertain how they could best be re-established in the plant population.

Visitors to the field day inspected the following trials:

Succession and Regeneration Trial B20.

A paddock was made sheep-proof in 1951 and sheep were excluded. The sheep-proof fence did not keep out the kangaroos and it was found that continuous grazing by the marsupial pests resulted in palatable herbage such a Curly Spinifex *(Plechtrachne Schinzii)* being eaten down so severely that it was prevented from seeding and building up root reserves.

The unpalatable species such as Woolly Spinifex *(Triodia lanigera)* and *Acacia*

translucens seeded freely in the absence of competition and soon comprised the bulk of the plant population.

A small area in this paddock was made vermin-proof and in this enclosure the *Plechtrachne* soon dominated the plant population.

Succession and Regeneration Trial A20.

On a different type of country a vermin-proof paddock was erected in November, 1951, but, despite the protection, the unpalatable Woolly Spinifex has dominated the area.

A few native grasses (*Eriachne* species) made their appearance but appear to be declining. Such poor soils apparently cannot be expected to provide more than meagre pickings at any time. Seeding with kapok bush and native grasses did not produce worthwhile results.

Management Trial (Woodstock Ram Paddock).

In this trial, which was designed to determine the yields and composition of typical spinifex country under different treatments four 8-acre vermin-proof plots were left ungrazed and four others grazed intermittently at a rate equivalent to one sheep to four acres. The stocking was carried out when the seeds of the grasses and plants had matured.

Rather surprisingly, the stand of native grasses was improving more rapidly on the stocked plots than on those kept unstocked. Grasses and shrubs which had not been seen in the area for upwards of ten years were re-appearing and multiplying.

Burning of the spinifex followed by heavy grazing gave promising results in these trials.

Continuous v. Deferred-Rotational Grazing.

This trial attracted much attention. A 12-acre plot was vermin-proof fenced and four sheep have been running in this area for two years. The sheep were in good condition but there was a definite decline in the quality of the herbage—a gradual eating-out of the grasses and shrubs, including the better spinifex species, and a corresponding increase in the less desirable types of vegetation.

Alongside the 12-acre plot, in identical country, another 12 acres had been enclosed and divided into 12 one-acre blocks.

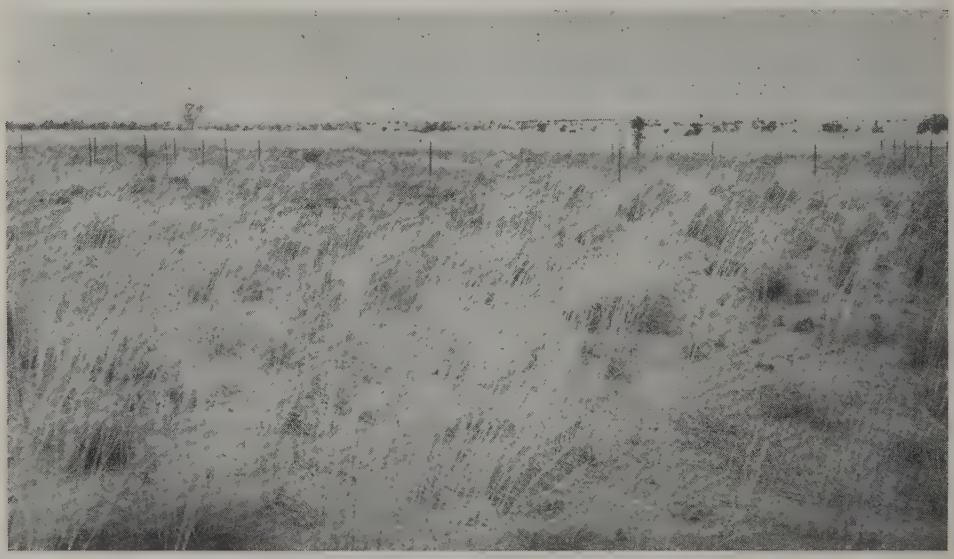

Fig. 6.—Another view of the 8-acre Management Trial showing good growth of Perennial Weeping Grass, a species seldom seen in the region under normal conditions of continuous grazing.

Fig. 7.—The "China Wall" at Abydos Station. This unusual rock formation is about 35 ft. in height and only 8 to 10 ft. in thickness.

Four sheep were running in this area also, being moved from one one-acre plot to the next every two weeks.

Four of the one-acre plots were submitted to "deferred grazing," a practice which seems to hold the key to much of the regeneration work in this area.

Although this subdivided 12-acre area was carrying the same number of sheep as the adjoining 12-acre plot, the herbage was obviously improving instead of declining. The palatable species were increasing rapidly and the sheep were in excellent condition and were likely to hold their condition better in the ensuing months than their neighbours whose feed was very evidently declining in quality.

"DEFERRED GRAZING"

This term is one that has been coined to describe a system of management which is becoming increasingly popular, following upon the convincing demonstrations at Abydos and Woodstock.

Briefly it consists of removing the sheep from certain paddocks—say one-third of the property—from the time of the first rains, for a period sufficiently long enough to allow the plants to mature. In these areas this is only a period of about eight weeks' duration.

This "spelling" of the area gives the perennial grasses an opportunity to develop fully—to manufacture the necessary crown and root reserves and to set seed.

Following upon the "spelling" period, the area is stocked heavily. There is usually a good bulk of feed at this stage and the heavy stocking ensures that a proportion of the shed seed is trampled into the ground and prevented from being eaten by birds or insects, or being blown or washed away.

Fig. 8.—End view of the "China Wall."

That this system is effective was illustrated in numerous instances of groups of seedlings surrounding the "parent" plants on areas where "deferred grazing" had been practised.

It is suggested that "deferred grazing" should be practised for two successive wet seasons on each area so that the whole of the property would be treated in a six-year period.

Adaptations of the treatment would, of course, have to be made to suit individual conditions but "deferred grazing" is already proving its worth in large-scale trials by interested station managers.

VERMIN CONTROL

Obviously, there are many areas where the effects of deferred grazing—or indeed any other form of management practice—would be nullified by kangaroos.

Where no surface waters were available, the closing down of mills during the critical period would help. Incidentally it is worth noting here that observations suggest that the local euros are largely creatures of habit. Once they have become accustomed to drinking at a mill, they seldom leave that area and I was told that the closing of a mill often killed many kangaroos although another mill was operating less than two miles away.

However, it is realised that vermin control must inevitably play an important role in the regeneration of the spinifex country and a research officer of the Commonwealth Scientific and Industrial Research Organisation (Wild Life Survey Section) is now stationed at Woodstock in an attempt to find a solution to the problem.

He is Mr. E. Ealey, whose last assignment was a vastly different one—he was in the Antarctic studying seals.

A feature of the Abydos field day was a series of informal talks and discussions on the lawn of the homestead in the evening following the inspection of the field plots.

Mr. Ealey gave an interesting talk on his current work at which he said that although most pastoralists thought in terms of some disease which would wipe out kangaroos in much the same manner that myxomatosis had wiped out the rabbit, he could not hold out much hope of such a solution at this stage.

Highly specific diseases which would confine their activities to one species of animal were rare, he said, and, although this angle was not being neglected, he thought that poisoning offered the best chances of success at present.

To inaugurate a successful control campaign, it was essential to know all there was to know about the animals concerned. He had already learnt much about the euro by talking with station men and he was anxious to receive all the information they could give him.

Much of the preliminary work at Woodstock had been in evolving techniques which would assist them in learning more about the animals. To obtain live animals for marking, euros were caught in netting funnel traps but they went crazy in the enclosures and often injured themselves.

By treating drinking water with chloral hydrate they were able to put the euros to

Fig. 9.—The Woodstock Station homestead. Originally an hotel on the track from Roebourne to the Tambourah Goldfield, the building now serves as a centre for C.S.I.R.O. Wild Life Survey personnel who are studying the kangaroo problem.

sleep for periods of up to six hours during which they could be ear-tagged or marked with identification numbers.

Ear-tags were fitted with reflector tape in different colours so that the "roos" could be identified at night by flashing a torch towards them.

Electronic devices for counting the number of euros visiting a certain mill and even for automatically spraying dye on kangaroos patronising salt licks were among other techniques mentioned.

Mr. Ealey said that there was much work still in progress but he was hopeful of evolving suitable poisoning methods which would establish an effective measure of control. He thought that poisoned water and poisoned salt licks offered good opportunities for large-scale kangaroo destruction.

NATIVE PLANTS SAFEST

In an interesting talk, Professor Phillips said that he thought that we were adopting a wise course in trying to re-establish the indigenous plants. He said "I think that the U.S.A. has spent far more than any other country in the world in seeking out and introducing plants from abroad—and I think that most of the money was spent in buying trouble."

He urged his listeners to think in terms of "plant husbandry"—the word "husband" meaning "to take care of."

"Always remember," he said, "that it is not the sheep which are Australia's greatest asset, but the plants on which they feed. Guard those plants carefully, because without them you could not have sheep flocks."

Mr. Marriott showed a series of slides of pastoral country in Queensland showing work being done in that State with Buffel and Birdwood grasses.

Mr. Suijdendorp also exhibited a number of slides showing the work at Abydos and Woodstock, after which some keen discussions rounded off a day in which good fellowship and some valuable educational experiences had been happily combined.

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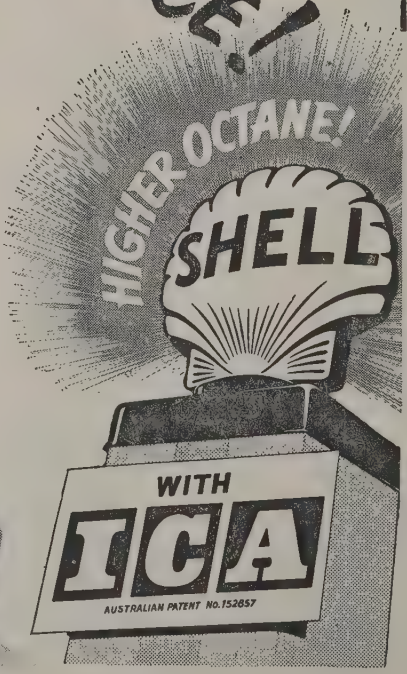

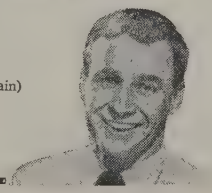

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MYCOTIC DERMATITIS ("LUMPY WOOL") AND FLEECE ROT OF SHEEP

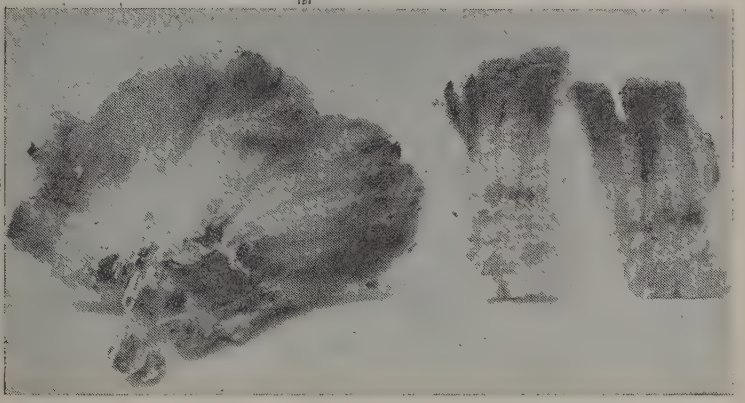


Fig. 1.—Mycotic dermatitis. Note matting of wool fibres with crusts of hardened exudate.

By
C. R. TOOP, B.V.Sc.
Chief Veterinary Surgeon

DURING seasons of heavy rainfall, specimens of wool showing evidence of matting and sometimes discolouration are frequently received for examination. Two similar but quite distinct conditions have been recognised, namely mycotic dermatitis ("lumpy wool") and fleece rot, which not only damage the fleece and reduce its value, but also render affected sheep susceptible to blowfly strike.

Both of these diseases are dependent for their development upon the presence of moisture in the wool and are most likely to occur during seasons of excessive rainfall when the fleece is frequently soaked with water.

Both have been known to occur in Western Australia for many years but there can be little doubt that their incidence has increased with the development and stocking of properties in the wetter districts.

MYCOTIC DERMATITIS ("LUMPY WOOL")

This condition is caused by the fungus *Actinomyces dermatonomus* the spores of which are often present in the soil and may enter the wool with dust. During seasons of high rainfall, when conditions of moisture are favourable to the propagation of this organism, it grows in the wool and invades the underlying skin setting up a condition of inflammation or dermatitis accompanied by exudation and the formation of crusts or scabs which bind the wool fibres firmly together. As the condition develops, areas of hard matted wool make their appearance in the fleece. These are roughly circular in outline measuring from ¼in. to 1in. or more in diameter and extending from 1in. to about 3in. along the wool fibres giving rise to hard horn-like processess projecting upwards like fingers into the fleece.

To outward appearances the full-woolled sheep is usually normal and the condition may not be discovered until shearing has commenced. The lesions are usually confined to the back and sides of the animal but occasional cases have been observed where other portions of the body, including the head and limbs have become affected. In advanced cases, separate areas of the affected wool may become confluent and in consequence large areas of the skin become covered with hard masses of matted wool which is firmly adherent to the underlying skin leaving a raw bleeding surface if forcibly detached. With the

passage of time, the crusts tend to separate from the skin and are pushed outwards by a new growth of wool from beneath and may subsequently be shed.

Mycotic dermatitis is largely a disease of young sheep; older animals are much more resistant and the disease does not usually recur, so that an animal affected during one season is generally found to be free of the condition at the following shearing.

Fig. 2.—Mycotic dermatitis. Note lumpy condition of wool with hard, matted areas

The disease has been observed chiefly amongst Merinos, but crossbreds are also susceptible and occasionally cases have been reported in the British breeds.

The general health and condition of affected sheep are not seriously impaired but considerable losses may be sustained from the reduction in the value of the damaged fleece. Furthermore the presence of the hard horn-like lumps in the wool renders shearing difficult and frequently impossible.

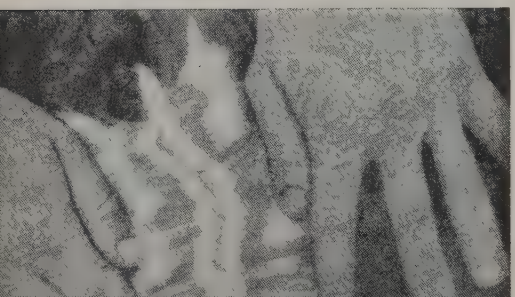
Prevention.

The fungus is destroyed by copper sulphate or zinc sulphate in a strength of 1 in 500. Dipping in these solutions, which may be prepared by the addition of 1 lb. of copper sulphate (bluestone) or of zinc sulphate to every 50 gallons of water may therefore be found effective as a preventive measure.

Dipping must be carried out in late autumn in order to obtain a satisfactory result but treatment of this kind at a time when ewes are forward in lamb and the flock is carrying six to nine months wool is unlikely to find favour with sheepmen.

Dipping off-shears in the spring cannot be recommended as a control measure since the spores of the fungus may continue to enter the fleece throughout the summer and autumn months and the disease may still occur. It should, however, be remembered that it is unlikely to assume serious proportions except in excessively wet years.

Fig. 3.—Fleece rot. Note band of matted, discoloured wool. The later growth of wool, closer to the skin, is unaffected



FLEECE ROT

Like mycotic dermatitis, fleece rot occurs under conditions of excessive rainfall. Prolonged wetting of the skin causes the outer layers to swell and soften and results in the development of a mild dermatitis (inflammation of the skin) accompanied by exudation and the formation of crusts at the base of the wool fibres which mats them together.

The examination of an affected sheep will reveal the presence of a greyish yellow band of matted wool ⅛in to ½in. in width at a level in the fleece corresponding to the period when the inflammatory process occurred and should the condition recur with the onset of further rains, a second band may be observed but at a lower level closer to the skin. The wool covering the withers, back and sides is most commonly affected.

Young sheep six to 12 months old are more severely affected probably on account of the openness of the fleece which allows the penetration of moisture. Sheep of all breeds are susceptible but the condition has been frequently observed in Merinos.

The exudate on the skin, when associated with warmth and moisture provides an excellent medium for the growth of bacteria, some of which produce pigments which discolour the wool. Colours ranging from yellow, green, blue and red to brown, black and violet have been observed. The green discolouration commonly observed in this State is caused by the organism *Pseudomonas aeruginosa*. The colour is usually confined to the matted bands of wool but may be diffused throughout the greater portion of the staple extending almost to the tip.

Cause.

Recent research has shown that the occurrence of fleece rot is influenced by certain fleece characteristics the most important of which is the proportion of wax to wool. Wax has a waterproofing effect and helps to protect the fleece from wetting by rain: thus the high wax content of low-yielding fleeces increases resistance to penetration by rain so helping the sheep to resist fleece rot. High-yielding fleeces with a lower wax content on the other hand are more readily penetrated by water, and sheep with such fleeces may therefore be expected to be more susceptible to fleece rot.

The ability of the skin to withstand continuous wetting regardless of any protection that may be afforded by the wax content of the fleece is also a factor of considerable importance. The skin of some sheep is tolerant to continuous wetting and such sheep are resistant—they neither develop dermatitis nor suffer from fleece rot. The skin of susceptible sheep by contrast is intolerant to prolonged wetting—they develop dermatitis with characteristic lesions in the fleece.

Differences in susceptibility have been observed in certain families of Merino sheep and there is reason to believe that this variation in skin reaction is inherited. Recent observations have shown that faulty conformation such as "pinch" or "grip" behind the withers does not increase the susceptibility of sheep to fleece rot and that it is not a predisposing factor.

Prevention.

Shearing immediately prior to the onset of the rainy season when the disease is most likely to occur has been advocated as a means of preventing fleece rot but this procedure will rarely be found practicable in the fleece rot-liable areas of Western Australia. A short fleece, while readily penetrated by rain, dries out very rapidly and seldom becomes affected by fleece rot.

BLOWFLY STRIKE

Sheep affected by both fleece rot and mycotic dermatitis are rendered susceptible to attack by blowflies. An odour attractive to the fly is produced and the moisture present is favourable to the development of the maggots. Extensive strikes involving the withers, back and sides may result and unless promptly treated these may cause the death of the animal. Treatment involves the removal of a considerable quantity of the most valuable part of the fleece. Sheep may of course be protected against body strike by spraying or jetting with D.D.T., B.H.C. or dieldrin in the recommended strengths.

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FARM WATER CONSERVATION

CLAY CORE DAMS

By H. B. WILSON, M.D.A., Irrigation Officer

ALTHOUGH this article applies mainly to those farms which are situated in areas served by semi-permanent creeks—in other words farms that have an abundance of water for all purposes during the winter months, but suffer a water famine during the summer, there is no reason at all why a permanent creek should not be dammed.

Should a farmer decide that it would be to his advantage to dam a creek which traverses his property, he must consider the following points:—

(1) Suitability of site.
(2) Availability of good clays for construction.
(3) Alkalinity or otherwise of water to be impounded.

SUITABILITY OF SITE

The perfect site at which to dam a creek is very seldom available and it is usually necessary to choose the best that is offered. The wall should be placed at a point along the watercourse where the slopes of the adjacent high ground come together as close as possible leaving a wide basin upstream in which the water can be trapped. This gives a short wall which in turn means that for the least amount of cash expended on actual construction the greatest amount of water is being impounded. Fig. 1 gives an illustration in plan form of the above remarks.

Another point to consider in choosing the site is that much more water will be impounded behind a wall ten feet high built across a creek at a point where the general fall of the creek is 1 foot in 100 feet than will be behind a wall ten feet high built where the general fall is 1 foot in 20 feet, as is illustrated in Fig. 2 (shown in elevation.)

As well as the above two points the farmer has to consider the question of whether he will be able to impound sufficient water for his requirements, and this is particularly important. Let us assume that he is an orchardist and has decided that it would be advantageous to irrigate his ten acres of apples.

Generally speaking, two waterings would be required, one probably early in January, the other about the end of the month. Each of these irrigations would

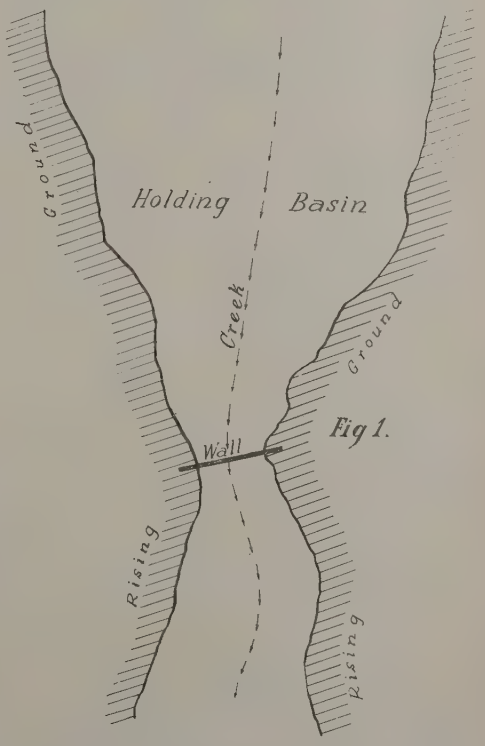

Fig. 1.—A point where a short wall can link the high ground and give a wide holding basin is the ideal site for a dam.

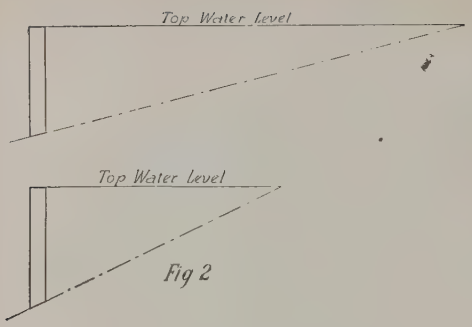

Fig. 2.—This diagram shows the greater quantity of water which can be impounded if the general fall of the creek-bed is gradual.

require a minimum application equivalent to 2in. of rain per acre which in turn means that 45,320 gallons would be needed for each acre at each watering. Therefore, on the 10 acres of orchard he will require 453,200 gallons stored for each irrigation. This does not take into consideration the effect of evaporation which would probably be as high as 33 per cent.

Working on the above figures and assuming only two waterings will be necessary we arrive at the following result:—

	gallons.
At each watering 1 acre requires	45,320
For two waterings 1 acre requires	90,640
At each watering 10 acres requires	453,200
For two waterings 10 acres requires	906,400

Therefore, **minimum** total capacity of dam needs to be 906,400 gallons plus allowance for evaporation. In the above case it has been assumed that the farmer was irrigating by sprinkler method. For furrow irrigation, the dam capacity would need to be doubled at least, as it would be very difficult to apply less than 4in. per acre by furrows.

The potato grower is another primary producer who can benefit immensly from irrigating his crops. As a general rule he would need to apply the equivalent of 1in. of rain every 10 to 14 days during the growing period, probably four waterings, depending on the severity of the season. From this then it is a simple matter to calculate the amount of water in gallons, it would be necessary to conserve say for a ten-acre crop—

	gallons.
At each watering 1 acre requires	22,660
For four waterings 1 acre requires	90,640
At each watering 10 acres requires	226,600
For four waterings 10 acres requires	906,400

Therefore, the **minimum** total capacity of the dam should be 906,400 gallons plus an allowance for evaporation.

When the farmer knows that 1 cubic yard holds 168 gallons it should not be too difficult to work out, fairly accurately, how much water he can impound by build-

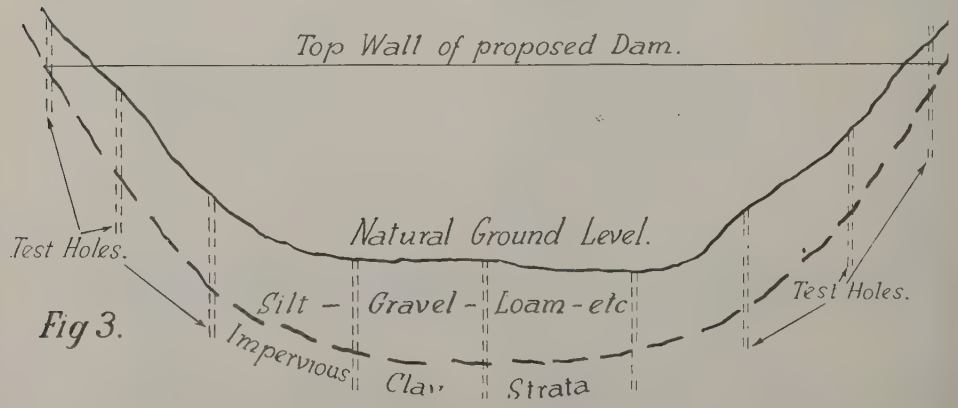

Fig. 3.—Elevation drawing showing location of test holes.

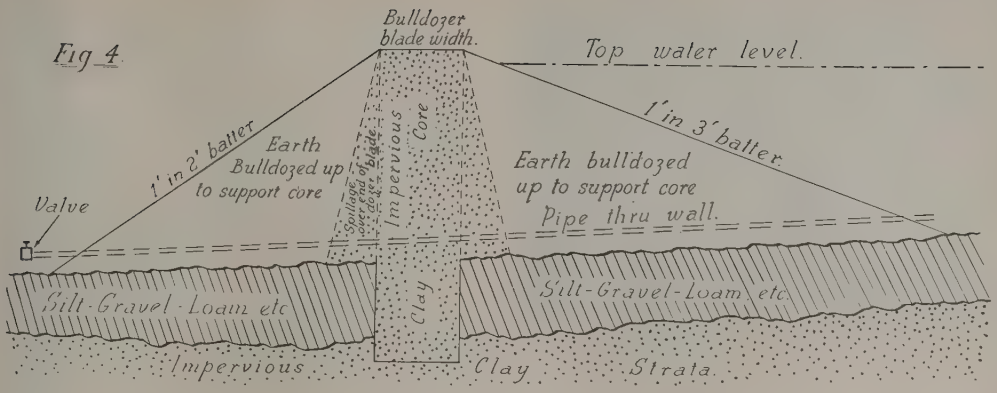

Fig. 4.—Elevation drawing giving details of clay core dam construction.

ing a wall of a certain height across a gully and therefore have adequate storage for his requirements.

Before leaving the question of storage space, it may be as well to give some idea of domestic and stock requirements; the following figures are intended to serve only as a guide to daily consumption.

	gallons.
Per member of the family all purposes	40-50
Milking cows	12-16
Dry Stock (cattle and horses)	10
Sheep	1½
Pigs	3
Per 100 head of poultry	3½-4

Example:

Assume stock comprises:—

	gallons per day.
1,500 sheep 1½ gallons x 1,500	2,250
6 horses 10 gallons x 6	60
75 dry cattle 10 gallons x 75	750
Total	3,060

3,060 gallons x 365 days—1,116,900 gallons per year. Plus evaporation.

AVAILABILITY OF GOOD CLAYS

Having decided that he has a site worth persevering with, the next step is to examine the underlying layers of earth to determine whether a good clay is present to furnish an impervious foundation for the wall, also to investigate the surrounding high ground to assure himself that good pug clay is available for the actual wall construction.

To examine the underlying layers of earth on the line of the proposed wall it is necessary to sink test holes, preferably with a 2in. extending auger approximately every 15 feet to 20 feet along the line, these holes to penetrate until a good impervious clay is encountered. It is not uncommon to have to penetrate to a depth of 10 feet or more. Fig. 3, drawn in elevation, explains this point.

A simple test to carry out to determine whether a clay is really suitable for foundations and the construction of a clay wall, is to mould a piece of it into the shape of a cup, fill this cup with water and leave it to stand overnight. If the clay has disintegrated in the morning it is not very suitable material for the job and further investigation should be carried out.

ALKALINITY OR OTHERWISE OF WATER TO BE CONSERVED

Naturally enough a settler would not be interested in conserving highly salt water for either stock, domestic, or irrigation

Fig. 5.—Photograph showing the gullet which is cut through to the impervious clay.

purposes, but, when a sample of water has as much as 200 grains per gallon present in it, it is very difficult to detect and therefore testing for salt content should be carried out by a competent authority before any further expense is incurred.

Samples For Analysis.

Samples of water for stock, irrigation and domestic purposes, are analysed by the Government Chemical Laboratories, Adelaide Terrace, Perth, on compliance with the following requirements:—

A. Each sample should—

(a) Be approximately one pint of water in a clean container which has been previously rinsed with the water to be tested.

(b) Be clearly marked with the sender's name, address and date of sampling.

(c) Be securely packed and addressed to the Government Chemical Laboratories.

B. At the same time, a letter should be forwarded stating—

(a) That the applicant is a bona fide farmer, market gardener, grazier etc., and that the analysis is required in connection with his business as such.

(b) The source of the sample, e.g. bore, well, spring, etc., and its depth, and the location number of the property from which the sample was obtained.

(c) Enclosing the fee of 7s. per sample. This fee applies only to those who qualify under paragraph (**B**) (a) otherwise the fee is £1 1s. per sample.

Should the analysis be required very urgently, this should be stated in the letter and the cost of a telegram added to the fee, when a telegram will be sent immediately the analysis is completed.

In dealing with permanent creeks, these test samples should be forwarded each month from October through the summer to and including March, each sample being taken at monthly intervals.

The following table gives a guide to the standards at present in use in this State as the safe upper limits of total salts in water for stock:—

	Grains per gallon.
Poultry	200
Pigs	300
Horses	450
Dairy cattle	500
Beef cattle	700
Adult dry sheep	900

437.5 grains—1 oz.

For irrigation purposes where **drainage is good** up to **70 grains** total salts per gallon is suitable for growing **all types of plants** including the salt susceptible ones.

Water containing **up to 150 grains** total salts per gallon is suitable for growing most plants **other than those susceptible to salt.**

Water containing **up to 220 grains** total salts per gallon has been used for growing tomatoes, lucerne, cabbage and other **salt-resistant plants.**

Above these limits, care should be taken to observe closely the growth and conditions of plants or herbage, and if considered necessary, to obtain advise from the officers of the Department of Agriculture.

Generally speaking 220 grains of total salts per gallon is regarded as approaching the maximum for safe watering of any plants. With such salt content the drainage should be excellent and each watering

should be of sufficient quantity to leach accumulated salts to a level below the root zone.

For domestic purposes and for human consumption on individual farms the safe upper limit of total soluble salts is considered to be 150 grains per gallon.

Water containing up to 300 grains per gallon may be used for showers and baths and water containing up to 700 grains may be used in a septic tank system.

It is suggested that Leaflet No. 2125—Waters For Agricultural Purposes in Western Australia—be obtained from the Department of Agriculture, Perth, for further information on this question.

CONSTRUCTION DETAILS FOR EARTH WALL DAMS

Having decided that the water to be impounded is of a sufficiently high quality and that a site and good clay are available, the farmer is now in a position to go ahead with the actual construction programme.

An earthmoving contractor is generally engaged to carry out the construction and I would like to point out that the contractor should have the job at heart as from now on the success of the whole set-up rests with him and his ability to take pains with the job.

Assuming that a bulldozer is being used, the first step is to clear away any trees etc., that may be growing adjacent to the site of the proposed wall. Having done this, a gullet is cut throughout the entire length of the wall site, the operator now concentrates on this gullet, shifting all the overburden until he eventually reaches the impervious clay which has been located by the test holes put down at an earlier date. See Figs 5 and 6.

Having completed the excavation work on the gullet the contractor commences to bring in the pug clay from the site already selected to supply this material. The clay is brought in and the gullet eventually filled, the operation being continued until the clay is approximately one foot above the level of the original creek invert when the farmer, if he intends to do so, should lay a 4in or 6in. Fibrolite or Hume concrete pipe through the wall. This can act as a sluice pipe to clear siltage at a later date or it can be utilised to connect irrigation pipes to if the land below the dam lends itself to irrigation farming.

When laying this pipe the farmer should assure himself that the clay is particularly well pugged around the pipe throughout its length and so make certain that water cannot possibly seep along the pipe and eventually cause a collapse of the wall.

Having satisfied himself that the pipe is laid and pugged well the farmer can now let the bulldozer operator carry on with the job of bringing in the clay, making sure that he drops a few loads gently over the pipeline before he attempts to

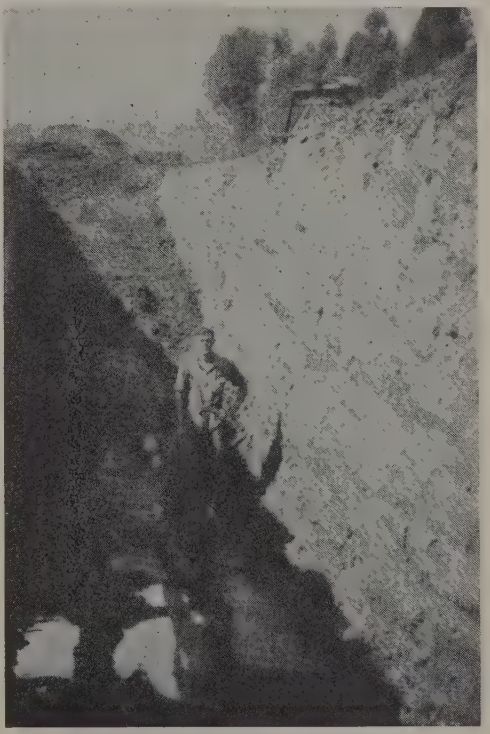

Fig. 6.—Another view of the gullet.

cross it with the machine thus making sure that it is well protected and will not buckle when the machine does eventually cross it. The clay is brought in until the top wall height is reached. As the height of the wall increases the farmer will find that he will have to add more lengths of

Fig. 7.—A well-constructed by-pass.

pipe to both upstream and downstream ends of the line because as the wall increases in height it also increases in width as the clay spills over the ends of the bulldozer blade.

The wall is now completed as far as height is concerned but its slope on both upstream and downstream sides is not yet correct, and earth, not necessarily pug clay, but good strong material is bulldozed up to the wall until a batter of 1 in 3 on the upstream side and 1 in 2 on the downstream side is obtained, again the farmer having to add lengths of pipe as the batter takes shape.

When the downstream batter is correct, a valve should be fitted to the outlet of the pipe to enable the flow to be shut of when necessary. (Fig. 4.)

Having done this the wall is complete and the contractor concentrates on the overflow bypass.

The overflow bypass of any earth wall dam is one of the most important features of the whole construction programme because a natural watercourse has now been dammed and practically every winter it will come about that the dam is completely full and another downpour of rain occurs. When this happens, the man who has provided for efficient bypass of excess water, has nothing to fear, but the person who has built a dam and not supplied a suitable bypass can strike serious trouble.

The water level will build up until it eventually flows over the crest of the wall washing away more and more of the clay until the wall is partially, if not entirely, washed out. It can not be too strongly stressed that an efficient bypass is very very important.

An efficient bypass is one that can quite easily handle the amount of water that would normally have flowed down the creek when it was running at flood level, so it can be seen that no hard and fast size can be given here for a bypass, and that each creek or watercourse that is dammed will require a bypass designed for it.

A point to remember is that the bottom or invert of a bypass should be at **least** two feet below the top wall level and will of course have to be of a width to carry the creek when in flood.

The bypass should be cut at one end of the wall and carried around the hillside on a grade at least equal to if not slightly more than the original creek and for such a distance that when the water again enters the watercourse it will have no eroding effect on the toe of the downstream batter and therefore completely protect the wall. (See Fig. 7.)

Where the bypass cuts around the end of the wall it may be found necessary to place stone grouted in with cement to stop any erosion at this point.

The Irrigation Branch of the Department of Agriculture have field officers available for on-the-spot advice regarding problems dealing with stock, domestic, and irrigation water supplies and it is suggested that farmers write to the Department if they are desirous of receiving helpful information.

IRRIGATION IN WESTERN AUSTRALIA

Government Controlled Schemes 1953-1954

Fig. 1.—Concrete-lined supply channel delivering water to a section of the Harvey Irrigation District.

THE increasingly important part which irrigation is playing in Western Australian agriculture is emphasised by this report on the Government controlled irrigation areas in the Harvey, Collie and Waroona districts.

Irrigated pasture, fodder crops, orchards and vegetable plots have shown a steady increase in acreage over the years, with a marked expansion of production, particularly in the dairying and fat stock spheres.

HARVEY IRRIGATION AREA

The total area irrigated was 10,593 acres, an increase of 1,204 acres on last year. The acre waterings for the year were 53,183, an increase of 6,640 acres. The average number of waterings per acre was 5.02 as compared with 5.12 last year.

The area of irrigated pasture increased by 476 acres to 7,659 acres. The average number of waterings given to this irrigated pasture was 5.83.

This area is showing a very healthy and steady increase in production and land utilisation and it is anticipated this trend will continue and increase in tempo for some time to come.

Fig. 2.—Concrete supply channel showing cattle stop.

COLLIE IRRIGATION AREA

The area irrigated was 9,063 acres an increase of 117 acres on the previous season. The acre waterings were 44,374, a decrease of 561 acres. The average number of waterings per acre was 4.90 compared with 5.02 the previous year.

Irrigated pasture increased in area by 91 acres and the average number of waterings was 6.41 compared with 6.58 the previous year.

Due to a shortage of water in Wellington Dam, which supplies this area, a system of rationing is introduced each season to eke out supplies. From the end of March, only 50 per cent. of available water is supplied to perennial pasture, the balance being reserved for early winter feed potatoes and vegetables etc. This factor accounts for the low rate of increase in perennial pasture.

Therefore much further expansion and increased production cannot be effected here until the water storage is increased by the raising of the Wellington Dam.

1952-53 AND 1953-54 IRRIGATION WATER UTILISATION FIGURES.

Western Australian Government-controlled Schemes.

District.	Permanent Pasture.		Dry Land for Early Winter Feed.		Fodder.		Potatoes.		Vegetables.		Pumpkins.		Orchards / Vines.		Softening.		Total Acres.	
	1952-53.	1953-54.	1952-53.	1953-54.	1952-53.	1953-54.	1952-53.	1953-54.	1952-53.	1953-54.	1952-53.	1953-54.	1952-53.	1953-54.	1952-53.	1953-54.	1952-53.	1953-54.
Collie	5,510	5,601	2,732	2,540	152	316	109	323	106	108	....	47	6	13	331	115	8,946	9,063
Harvey	7,183	7,659	1,137	1,804	257	425	387	458	140	136	....	76	259	235	26	....	9,389	10,593
Waroona	2,017	2,132	....	....	154	184	235	225	276	83	....	269	3	3	114	....	2,799	2,896
Total, All Districts	14,710	15,392	3,869	4,144	563	925	731	1,006	522	327	....	392	268	251	471	115	21,134	22,552
Percentage of Land Irrigated	69·60	68·23	18·30	18·38	2·66	4·10	3·45	4·45	2·45	1·45	....	1·74	1·26	1·11	2·22	0·51	99·95	99·98
Acre Waterings	87,046	90,312	8,445	8,333	2,235	3,435	4,185	4,405	2,588	1,492	....	1,507	1,070	1,072	536	115	106,105	110,671
Average Number of Waterings	5·90	5·87	2·18	2·01	3·96	3·71	5·72	4·38	4·95	4·56	....	3·84	3·99	4·27	1·10	1·00	5·02	4·91
Percentage of Water Used	82·03	81·60	7·95	7·53	2·10	3·10	3·94	3·98	2·43	1·35	....	1·36	1·00	0·97	0·50	0·10	99·95	99·99

Permanent Pastures—Consist of perennial species such as paspalum, perennial rye grass, cocksfoot, etc., in association with white clover and occasionally strawberry clover.

Early Winter Feed—Watering of dry land for early germination of annual pastures, consisting of subterranean clover, annual rye grass and minor clover and grasses.

Fodders—Consist of maize, millets, sorghum and sudan grass chiefly.

In 1952-53 pumpkins were included in vegetables.

Land actually graded, 1952-53 season—705 acres by Government power graders, plus 858⅛ acres by farmers and contractors. Total, 1,563½ acres.

Land actually graded, 1953-54 season—964 acres by Government power graders, plus 947 acres by farmers and contractors. Total, 1,911 acres.

Drains channels, etc., excavated—1952-53, 1,104 chains ; 1953-54, 1,588 chains.

Cost of Watering—Basic rate, £1 2s. 6d. per acre. This sum allows two waterings and is a compulsory charge on all irrigated land within the scheme area. All further waterings cost 3s. 9d. per acre.

District.	Reservoir.	Type.	Depth of Water.	Capacity.	Acres.	Crest Length.	Area of District.	Ultimate Rateable Area.
			Feet.	Gallons.	Feet.	Feet.	Acres.	Acres.
Harvey	Harvey	Concrete	60	2,250,000,000	8,300	797	2,928	2,928
	Stirling	Earth Fill	150	12,000,000,000	44,344	900	29,735	10,077
Waroona	Drakesbrook	Earth Fill	54	504,000,000	1,855	580	10,325	3,441
	Sampson	Earth Fill	100	1,800,000,000	6,540	800		
Collie	Wellington	Concrete	65	8,700,000,000	31,500	1,200	28,762	9,288
			....	25,254,000,000	92,539	....	71,750	25,734

HARVEY (CENTRE OF IRRIGATION AREAS) RAINFALL.

	1951. Points.	1952. Points.	1953. Points.
January	19	8	2
February	88	16	149
March	2	185	9
April	168	10	55
May	313	634	641
June	978	1,212	1,074
July	549	432	612
August	657	530	252
September	195	432	266
October	316	376	509
November	97	116	173
December	167	60	5
Total	3,549	4,011	3,747

	Points.
Harvey (Centre of Area), Annual Average	4,014
Brunswick (South of Harvey), Annual Average	4,112
Waroona (North of Harvey), Annual Average	4,109
Pinjarra	3,784

WAROONA IRRIGATION AREA

The area irrigated was 2,896 acres, an increase of 97 acres on last year. The acre waterings were 13,114 an increase of 41 on last season.

The average number of waterings per acre was 4.53 compared with 4.67 last season. Permanent pasture received an average of 4.54 as compared to 4.77 waterings the previous season.

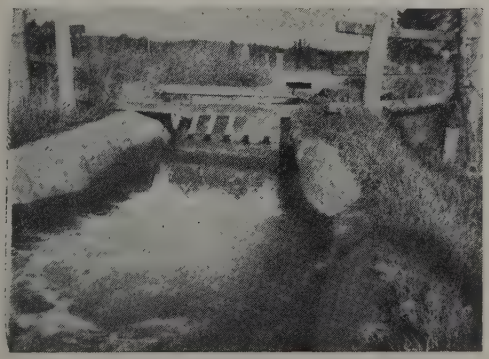

Fig. 3.—Lined supply channel showing concrete drop.

Fig. 4.—Earthen supply channel showing wooden check and drop.

Although an additional 97 acres were irrigated this season only a small increase in water was required. This is due, no doubt, to the low average number of waterings per acre and the lower percentage of pasture in the district. Waroona with an average of 3.57 waterings per acre.

Fig. 5.—Detheridge wheel which is used to measure water delivered to farmers (inlet on left, outlet on right, of picture).

Fig. 6.—Irrigated white clover, perennial ryegrass and *paspalum* pasture.

Although dryland for early winter feed is not irrigated in this area there is a considerable area, 670 acres, of permanent pasture receiving three or less waterings in a season. This fact is difficult to account for but may be allied with the growing of such species as *Paspalum dilatatum* and couch grass combined. With these species frequent waterings are not normally used. Another aspect is possibly the presence of a milk condensory in the district. As farmers supplying the condensory are not required to meet a milk quota there is no resultant pressure for a bulk of green feed in the late summer as in other areas.

Nevertheless the area is showing a gradual and steady increase in land utilisation and production.

WATER UTILISATION DATA

The attached water utilisation figures show that the total area irrigated in the Harvey-Collie-Waroona districts during the past season was 22,552 acres, and increase of 1,418 acres, and that the acre waterings were 110,671, an increase of 4,566 with an average of 4.91 waterings per irrigated acre. The previous season an average of 5.02 waterings has only 73.6 per cent. of the area under pasture, compared with an average for all districts of 86.61 per cent. while considerable areas are utilised for low water requirement crops e.g. pumpkins 269 acres were required. This decrease in the number of waterings is no doubt due to seasonal conditions. In 1952 effective rainfall ceased in October, and the season did not break till the following May. In 1953 effective rainfall did not cease till late November, and the season broke in April of this year. Therefore, the irrigation season was somewhat shorter but considerable drier than in 1952-53 as no effective falls of rain occurred during December-January-February-March.

Of the area of 22,552 acres, 68.23 per cent. was used for permanent pastures, and a total of 90.71 per cent. was used for pastures, clover and fodder crops in connection with dairying, whole milk supplies and fat stock purposes, 92.23 per cent. of water being used for the above purpose.

It is clearly seen that pasture production, both permanent pasture and early germinated annual pastures, under irrigation is our main feature with direct results in dairying, whole milk production and fat stock from these areas.

LAND GRADING AND IRRIGATION AREAS

An excellent season was experienced and a total of 1,911 acres were graded, compared with 1,563½ acres the previous season an increase of 347½ acres.

Fig. 7.—"The good old days." Three horses and a double-furrow disc plough being used in land preparation for grading.

This is a record year's grading for the State-Government-Power graders handled 964 acres and private contractors and farmers dealt with 947 acres.

The actual use of this land is of interest.

	1952-3.	1953-4.
Area graded	1,563½	1,911
Vegetables	42	58
Potatoes	292	366
Fodder crops	220	431
Annual pasture	143	153
Irrigated pasture	582½	700
Fallow	284	203

The above shows that the bulk of this land is put to immediate use and therefore has a direct influence on production from these areas.

Grading costs for work done by farmers and contractors are not available, but for work by Government-Power-Graders the following figures are of interest.

The farmers were charged £4 per hour for the hire of these machines, the same as last season, plus £5 2s. 6d. per hour on drainage work not connected with grading. The average cost per acre to grade by power grader was £7 8s. as compared with £6 19s. 6d. the previous season. The average time to grade 1 acre was 1.85 hours compared to 1.7 hours the previous season.

These power machines constructed 19 miles 68 chains of farm drains at an average cost of 4s. 4d. per chain. The value of these drains can be appreciated when it is realised that we are irrigating in 40in. rainfall. Of this 40in. rainfall an average of 33in. normally occurs during the months: May-September inclusive. On occasions as much as 20in. has fallen during the month of June with the annual aggregate as high as 60in. Therefore, it can be readily seen how necessary adequate drainage is if waterlogging and/or flooding of land is not to occur.

Fig. 8.—A very useful and most successful type of grading attachment to a medium-sized farm tractor. This type has been operating in our irrigation areas for many years.

Fig. 9.—The same outfit in operation with a full load.

Damage by Spraying Chemicals

On a number of occasions damage to cultivated plants has been associated with drift from weed spraying operations, the risk being accentuated by windy conditions. In several cases recently damage to plants has been traced to vapours originating from spraying equipment stored in the vicinity.

The Officer-in-Charge, Weeds and Seeds Branch of the Department of Agriculture (Mr. G. R. W. Meadly) said that the ethyl ester of 2,4-D a type used frequently as a herbicide, is volatile and if left in the tank, boom or hose of spraying equipment can give rise to vapours which may be blown for some considerable distance. The risk is greatest with high temperatures and injury has been caused by vapour arising from chemical spilt on the back of a truck. During February two instances of damage to plants including grape vines, tomatoes and lemon trees have been investigated. In each case the symptoms were typical of those caused by 2,4-D and equipment used for spraying weeds with 2,4-D ester had been stored nearby. No spraying had been undertaken.

With highly susceptible plants such as vines and tomatoes, a small amount of vapour can cause extensive damage and extreme care is essential with the storage of 2,4-D spraying equipment and material when such plants are nearby. This applies in particular to commercial areas where a large monetary loss could be involved.

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55 K

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The 55K gives you ample power for the biggest normal farm implements . . . power to work big areas quickly and thoroughly . . . reserve power for tough spots and bad conditions

Compare the type of transmission employed in the 55 Series Tractors—silent running, helical cut gears, mounted throughout on Timken Tapered Adjustable Roller bearings. The entire transmission including the final drive is supported on Timken bearings. Years of trouble free and silent operation are embodied in such a carefully designed and tested gear set up.

Advanced engineering features include:—Heavy-duty special kerosene engine with replaceable wet sleeves; full pressure oiling system; battery ignition with automatic spark control; voltage regulator; selective sliding and constant-mesh transmission; hydraulic velvet-ride seat; swinging drawbar; individual or coupled brakes; self-starter, lights, internal power take-off.

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THE FOREMOST NAME IN SUNSHINE AUSTRALIAN AGRICULTURE

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Fig. 1.—Foliage baiting to control the Mediterranean fruit fly. This imported pest established itself before we had an efficient Plant Quarantine Service. In damaged fruit and expensive control measures it must have cost Australia millions of pounds. So far, the Plant Quarantine Service has kept this State free from other varieties of fruit fly.

PLANT QUARANTINE

By T. C. MILLER, B.Sc. (Agric.), Assistant Superintendent of Horticulture

THE other day an enthusiastic gardener was complaining about the severe damage which snails are doing in her garden, and after discussing ways and means of preventing this destruction to her plants, I pointed out that once snails did not exist here but at some time or another were brought in from overseas. In fact, the early records of the Agricultural Department show that about 40 years ago a few snails were noticed around Perth, and all inspectors of the Department—the whole four of them at that time—were ordered to report to St. George's Terrace each Saturday and spend the morning collecting snails in an endeavour to prevent them spreading

Snails are just one of the serious pests that have found their way into Australia, and it is more than likely they would have been prevented if the Plant Quarantine service had been as efficient in those days as it is at present.

There are of course, many other very destructive pests and diseases which have come in from other countries, for example there is the fruit fly—a problem of both the commercial and backyard grower—which originated in the Mediterranean countries. But it must be remembered that there are still several other more serious kinds of fruit flies which do not exist in Western Australia and which must be kept out.

The rusts in our wheat, the red spiders and mites in our grasses and pastures, the fungus and virus diseases of our potatoes, tomatoes and other vegetable crops, the scales and fungi which infest our fruit orchards and the hosts of pests which worry our gardens, as well as almost all

our weeds of economic importance have at some time been innocently brought in from some distant country.

THE SIREX WASP

Perhaps one of the greatest quarantine problems of recent years was when due to the housing shortage, large number of timber prefabricated houses were imported from the Continent. Much of the timber was infested with a borer insect called the sirex wasp, and every consignment arriving had to be thoroughly fumigated. As thousands of tons of timber came in in this way, its treatment was an extremely difficult task.

The sirex wasp is one of the most serious pests of certain forest timber, and if it had found its way into our trees it would have caused great loss, particularly to the extensive pine plantations now growing so well close to Perth.

All timber, including boxes and crates, unloaded at Fremantle is now carefully examined for this particular pest. Crates containing certain makes of European vehicles are regularly found to be infested and appropriate fumigation or destruction of the crates is carried out.

Australia is most fortunate in that many serious plant pests and diseases have been kept out and Western Australia is particularly well off in this respect.

ORCHARD PESTS

There are three very important examples of the value of plant quarantine to Western Australia and they are the freedom from phylloxera, black spot, and codling moth enjoyed by our fruit growers.

Phylloxera is a minute insect which infests the roots of grape vines. It is extremely destructive and can wipe out large areas of vines in a short time. In the past it has devastated the vineyards of Europe and early this century it made its appearance in parts of some of the Eastern States of Australia. Strict measures appear to have controlled it in those States and have kept it completely away from this State and South Australia and as a precaution the importation of grapes, grape vines or cuttings is completely prohibited.

Black spot is a fungus disease and codling moth an insect, both of which attack the apple crop. We have always tried to keep these dangerous pests away, but in spite of every precaution a number of outbreaks have occurred in various apple-growing districts. Vigorous control measures have resulted in complete eradication, and Plant Quarantine inspection services are doing everything possible to prevent further introduction.

If these pests were allowed to establish themselves, as they would do without meticulous precautions, growers would have to spend many thousands of pounds each year on control, the quality of the produce would be lowered and our export trade jeopardised.

It is not only the person importing plants for sale who may bring in new pests with his consignments, but the ordinary traveller who, ignorant of the risks, brings plants, fruits, bunches of flowers or cuttings with him. To guard against these risks, qualified inspectors meet every plane arriving at Perth airport from Eastern State or Overseas, and every vessel arriving at Fremantle, while all interstate rail consignments are examined. All plant material is inspected by these officers and, if free from disease, it is allowed to pass. But it is surprising and sometimes quite alarming to see the prohibited and infested fruits which occasionally arrive.

PROHIBITED IMPORTS

In these days of increasing travel, immigration and rapid transport, with everyone becoming more conscious of what exists in other parts of the world, there is a greater interchange of plant material between countries and a consequent greater risk of the introduction of new diseases. It is most important to protect the established industries, plants and gardens within Australia and so vigilance of plant inspection services at points of entry must be maintained. It has been found necessary to completely prohibit the introduction of certain plants which might easily carry disease and which in any case can usually be quite readily obtained within Australia. Examples of material prohibited from overseas are the seeds of cereals such as wheat and oats, peanut plants, apples and pears, stonefruit

Fig. 2.—A demonstration of spraying to control codling moth. Despite careful precautions, the codling moth found its way into Western Australia on several occasions but vigorous control measures eradicated it. But for the Plant Quarantine Service, the codling moth would have become permanently established in our apple-growing areas.

trees, grape vines, and citrus trees from certain countries. Then because of the chance of becoming a serious weed as the prickly pear is in some places, all species of cactus are prohibited.

Other items may be imported under special conditions, for example bean seeds only for consumption and not for sowing and, to ensure they will not be grown, on arrival they are specially treated to destroy their viability. Tomato seed may only be introduced in sufficient quantity to establish a seed bed of a new variety.

GARDEN PLANTS

If you wish to import plants, garden shrubs, bulbs or corms from New Zealand, India, Holland or any other country, the following procedure should be carried out and this will enable you to obtain your plants without the risk of bringing in undesirable pests or diseases.

Application should be made to the Chief Quarantine Officer (Plants) at the Department of Agriculture, giving details of the plants you wish to obtain and their country of origin. If they are not on the prohibited list (and the ordinary run of plants are not) you will receive a permit and transport can be arranged. On arrival the plants pass through the normal inspection and are then fumigated to free them from insects of all types which may be present. They must then be grown in an approved nursery for the first season and, if they prove free from disease, are released.

With gladioli, only five corms of each variety may be imported from overseas and, after inspection, they must be grown in an approved nursery for the first season to ensure freedom from disease. This is an excellent and necessary protection for the growers within Australia, as in recent years gladioli corms from overseas have been the means of bringing in a number of new diseases.

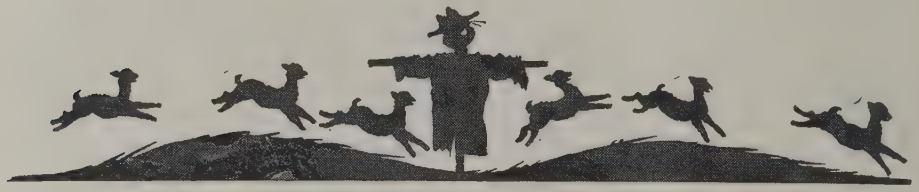
It is not possible to go into full details at this time and if you are contemplating the importation of any plant material, it would be advisable to contact the Agricultural Department for further particulars.

And a word of advice to those coming from the Eastern States bringing rooted plants from friends or those intending to purchase from nurseries there. Remember to obtain a declaration by the grower that the plants were not grown within 50 yds. of a grape vine and that phylloxera has not been known to exist on the property where the plants were grown. This is essential with rooted plants from all other states except South Australia, as a precaution against the chance introduction into this State, of the phylloxera insect which I mentioned before to be a serious pest of grape vines. Possession of this certificate is demanded by the authorities and will prevent any delay in receving the consignment.

The problems of plant quarantine can thus be seen, and I trust the absolute necessity of adequate inspections and precautions against new pests and diseases is fully appreciated.

Our country is free from many pests and diseases, and with everyone's co-operation we shall keep it that way.

(From a broadcast script made available by courtesy of the Australian Broadcasting Commission.)



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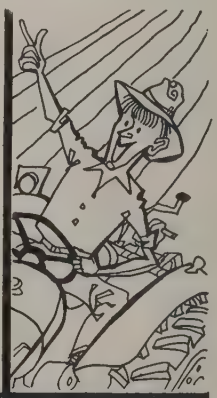

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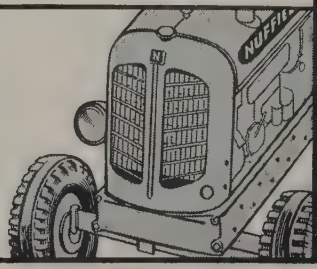

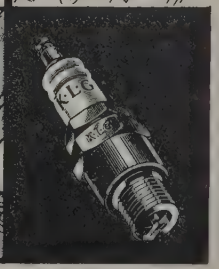

PHALARIS TUBEROSA

Toowoomba Canary Grass

By H. G. ELLIOTT,

Assistant Superintendent of Dairying

AS far as can be ascertained, the grass now known as Phalaris tuberosa was first imported from America in 1884 by the Queensland Department of Agriculture for trial at the Toowoomba Experimental Farm, hence the popular name, Toowoomba Canary Grass.

At the time of its importation it was known as *Phalaris bulbosa* and until about 18 years ago it was known by this name or as *Phalaris commutata.* Since that time, botanists have agreed that the correct nomenclature is *Phalaris tuberosa,* the name by which it is known today.

Apparently it was not until some 24 years after its introduction that the first favourable reports of the grass were published.

The Agricultural Gazette of New South Wales reported in October 1908 that *Phalaris* growing at the Hawkesbury Agricultural College had "leaves and stems that were soft and succulent and the plant grows to a height of 2½ft. It is a splendid grass for winter and spring feed and gives good growth to December, when it seeds. The plants are very frost-resistant and apparently very drought-resistant."

The Wagga Experimental Farm reported that is was "very promising as a pasture grass" and the Bathurst Experimental Farm stated that "the grass made good growth throughout the summer months, grew continuously through the winter and withstood frosting. The crowns of the plant are compact and withstand considerable trampling."

IN WESTERN AUSTRALIA

The plant appears to have been first grown successfully in this State by Mr. A. Snell at Harvey and by Sergeant W. Brodie at the Police Station, Donnybrook. Excellent growth of *Phalaris* plants can still be seen on the original areas, and also along the roadways near these sites.

Except where grown under irrigated conditions, *Phalaris tuberosa* gives early autumn winter and spring growth, and its productiveness is practically nil during the period from early summer until the event of the first autumn rains. It is capable of adapting itself to wet cold conditions and also to extreme dryness. Generally speaking, its adaptability to extreme conditions is amazing.

In Western Australia this grass appears to be well adapted to large areas of land

receiving a rainfall of 17in. or over, which is of the winter rainfall and summer drought type. At Wongan Hills Research Station, during the year 1938, with a rainfall of 12.76in. its persistence was remarkable, but very little growth was obtained; this grass, however, had been growing without a legume association.

The areas of *Phalaris tuberosa* growing in Western Australia are increasing but still comparatively small and the factors that appear to have contributed towards the restricted use of this grass are:—

(1) The absence or comparatively poor spread of Phalaris plants on non-cultivated land by means of seed.

(2) The early lack of adequate knowledge with reference to the methods of soil preparation and type, seeding and subsequent fertilising of this grass.

(3) The comparatively high price of the seed.

(4) The inability of the young seedlings to compete with strong growing annuals.

BOTANICAL DESCRIPTION*

"Perennial, caespitose, the culms more or less swollen at the basal internodes, or forming hard woody stocks, 2-4ft. in height, erect or ascending, sometimes geniculate below. Sheaths much shorter than the upper internodes, tight and striate; ligules long, thin, white and hyaline, truncate and soon becoming lacerated. Leaf blades firm, rather soft, prominently striate, tapering into long, weak, fine points. Panicle cylindrical, spikelike, up to 5½in. in length, compact, tapering at both ends or sometimes broader at the base, the spikelets usually erect, the peduncles ultimately long exserted.

"Glumes subequal lanceolate, rather straight, more or less acute but not long pointed, 3-nerved, the lateral nerves prominent; margins wide, hyaline but firm, keeled, flat, the keel produced into a prominent dorsal wing extending over the upper two-thirds of the glume and gradually narrowed at each end, minutely serrulate or entire and not notched. Sterile lemmas not very unequal, the lower about one-quarter, the upper on-third the length of the fertile lemma, both sparsely hairy, and appressed to the fertile lemma, more or less linear and concave. Fertile lemma acutely ovate-elliptical, silky with appressed hairs, faintly nerved, becoming firm in fruit; palea acute, slightly less in length than the fertile lemma, glabrous except for the terminal tuft of a few short hairs."

SEED AND STRAIN

Owing to the difficulty of detecting the difference between the seed of the valuable perennial type, *P. tuberosa,* and that of the inferior annual, *P. minor,* it is essential for the buyer to purchase certified seed only. The seed tester can, however, determine the difference between the two by the following processes:—

(1) On the germinating filter paper *P. tuberosa* shows a white tip to the rootlets, while *P. Minor* definitely shows a pink tip.

(2) Under the ultra-violet light (quartz lamp, seeds of the *P. tuberosa* when germinated on filter paper will show the roots clearly defined while with the *P. Minor* the rootlets are not at all visible.

Certification schemes have been instituted in Australia for *Phalaris tuberosa* seed, and farmers are requested to purchase only certified seed when obtaining their requirements. Both the South Australian and Western Australian seed have given and are giving good results in this State. At the present time new strains under test at Wokalup Research Station are showing great promise.

WHERE TO SOW

Because of its suitability to a wide range of climatic conditions *Phalaris tuberosa* is of great value as a pasture component. It is growing successfully in areas of 17 to 40in of winter rainfall, in summer drought conditions and in the irrigation areas.

At the Waite Institute in South Australia it proved to be one of the best perennial grasses for the district where the

* From article by C. A. Gardner and G. R. Meadly—Canary Grasses of W.A. Journal Department of Agriculture, W.A. Vol. IX, pp. 275-285, 1932.

summer months are hot and dry and the average rainfall below 24in.

This grass appears to be best suited to the heavier soil types, but will grow well on the lighter soils which have a clay subsoil not more than 12 in. below the surface. As an association with a legume is essential, it is recommended to establish it in old subterranean clover paddocks or sow the variety of subterranean clover most suitable to the district at the same time.

A mixture of *Phalaris tuberosa* and white clover in an irrigated pasture at Nannup.

SOIL PREPARATION

In areas of 25in. and under this is a most important factor for the future establishment and growth of this grass. It is recommended that a well prepared fallow, free of weeds and well consolidated be used. If this is available early seeding can be carried out. A firm consolidated seed bed is most essential for success. If fallowed land is not available the area to be sown should be lightly ploughed and worked down. After weed germination further cultivation will be required to destroy the weeds. After cultivation the area should be well rolled with a T-bar roller, the seed to be sown about mid-May and rolled or lightly harrowed in. Good results have been obtained by cultivating the area with a "combine" or springtyne cultivator after the weed germination has occurred. The seed is then mixed with superphosphate just prior to it being sown with the "combine" or drill set so that shallow planting is carried out. On lighter types of soil, deeper planting to 1in. can be adopted. It is recommended, however, that a well prepared seed bed be used, as a little extra trouble in the early stages is well repaid later.

TIME TO SOW

The seed may be sown from the middle of April on well worked fallow, until mid-September in the higher rainfall areas. Under irrigated conditions excellent results have been obtained from spring planting, and this is recommended when an association with white clover is required.

RATE OF SEEDING

Under all conditions 2 lb. of seed per acre is recommended and if subterranean clover seed is being sown at the same time, 6 lb. of subterranean clover seed and 2 lb. of *Phalaris tuberosa* seed per acre would be required. In the irrigation areas 2-3 lb. of *Phalaris* and 2 lb. of white clover seed per acre would be sufficient. It is not recommended to mix any seed of the ryegrasses with *Phalaris* at the time of establishment, owing to the vigorous nature of their growth in the early stages, which is detrimental to the establishment of the *Phalaris* unless excellent subsequent management with grazing is carried out. It must be remembered always that this grass is highly sensitive to competition in the early stages of growth, from any vigorous growing grass or weed, such as capeweed. Newer strains now being developed are more tolerant to weed competition. Clovers such as subterranean clover and white clover can, however, be grown, and are desirable in the initial establishment of *Phalaris*.

FERTILISER

At least 2 cwt. of superphosphate per acre should be used at the time of establishment, and a subsequent application of 1 cwt. per acre in the spring is advantageous. Two cwt. per annum should be used in the following years as a top dressing. On new land and unfallowed land that has not been under subterranean clover previously the using of 1 cwt. of sulphate of ammonia per acre at the time of planting may be beneficial.

MANAGEMENT

During the first year it is essential that weeds or any vigorous growing plants should not be allowed to dominate the young *Phalaris* plants. If necessary, infre-

quent quick, heavy grazing, should be carried out, and any subsequent grazing should not take place at closer intervals than 6-10 weeks, according to growth. Early in October, if weeds are still troublesome, mowing should be carried out and the field closed up to allow the *Phalaris* plants to produce seed heads. Once the plants have seeded grazing can then be carried out more or less indiscriminately until the autumn rains commence, then the grazing periods should be in about six weekly intervals. Once established, *Phalaris tuberosa* is thoroughly perennial, increases its basal size and, grazed judicially, forms a good turf in association with clover. It is succulent and palatable to stock of all kinds. It is a strong grower, and being a deep-rooting plant is reasonably drought-resistant.

BLACKBERRY CONTROL

Satisfactory progress in the control of blackberry by spraying with the synthetic hormone spray, 2,4,5-T has been made in the Warren district where two of the Agriculture Protection Board's mobile spraying units operated, in co-operation with the road board.

The rate of spraying has been accelerated by equipping the four-wheel-drive vehicles with trailers, thus enabling larger quantities of the weedicide to be carried and reducing the time spent in refilling.

Although rain prevented spraying for some days during February, the total area sprayed during the month was 40 acres. A total of 60 acres has been sprayed in the Manjimup, Middlesex, Yanmah, Dean Mill and Balbarrup districts.

The campaign is being regarded favourably in the Manjimup area where farmers have requested the loan of knapsack sprays to treat small areas of blackberry on their properties.

The Collie Coalfields Road Board is following up control work carried out in previous years, and the Bridgetown, Balingup, Busselton and Margaret River Road Boards have eradication programmes planned.

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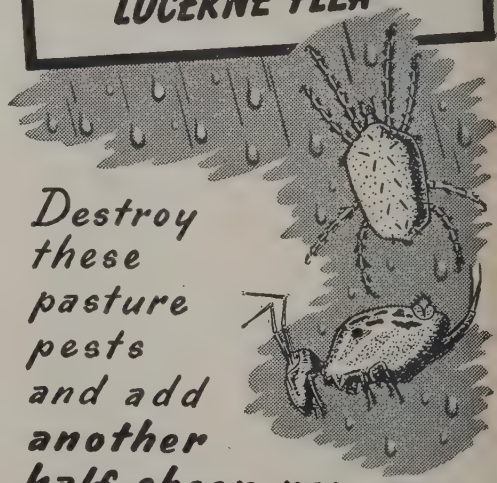

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PLANT DISEASES

DOWNY MILDEW OF ONIONS

Report on Fungicidal Spray Experiment

By R. F. DOEPEL, Plant Pathologist, and M. HARDIE, Vegetable Instructor.

DOWNY mildew of onions caused by the fungus Peronospora destructor is widespread in Western Australia. In market gardens adjacent to Perth where the majority of onions are grown the disease occurs each year in spring and early summer crops and often attains epidemic proportions. Onion mildew kills the leaves and so retards bulb development and as a result yields are often seriously lowered.

Spraying for the control of this disease has seldom been attempted in this State, but last season the control value of a number of spray materials was tested in a field experiment in the Spearwod district. One of the newer fungicides, zineb, gave an approximate 20 per cent increase in yield of marketable onions.

SYMPTOMS AND EFFECTS

Downy mildew first becomes noticeable on the basal or older leaves. These turn greenish-yellow, hang down limply and gradually wither back from the tips (Fig. 1). The disease spreads to the younger leaves which are killed progressively as they develop. The fungus may be seen on affected leaves as a grey-violet furry covering (Fig. 2) which is most evident in the early morning after rain or heavy dew.

Seedstalks may also be attacked by mildew and bend or break at the site of infection. As a result seed formation is prevented or if the seed matures it is often shrivelled.

Fig. 1.—Onion plants in an experimental plot at Spearwood showing leaves attacked by mildew. Affected leaves turn greenish yellow, hang down limply and wither back from the tips.

Fig. 2.—On left, typical appearance of onion plant badly affected with downy mildew. (After Walker.) On right, portions of onion leaves showing the furry growth of mildew which is most noticeable in the early morning after rain or heavy dew.

DISEASE DEVELOPMENT

The fungus grows in the leaf tissues and produces spores which are blown about by wind or splashed by water. These spores give rise to new leaf infections and so spread the disease rapidly through the crop and to neighbouring crops.

The fungus may progress inside the leaves down into the bulb; such bulbs if retained for seed purposes can carry the disease.

Resting spores, known as oospores, are also produced in the leaf tissues and can survive in diseased leaves in the soil to infect healthy plants the following season.

Mildew development is favoured by cool moist weather conditions; frequent dews encouraging prolific spore production by the fungus.

HOST RANGE

All varieties of onions are attacked as also are shallots, leeks and garlic.

TESTING OF SPRAYS 1954

Variable control of mildew with fungicidal sprays has been reported by overseas workers. In this State, the main fungicide used has been a lime sulphur—resin soap spray, each ingredient being used at 1 per cent. concentration.

Last year an experiment was conducted on a field crop of onions in the Spearwood district to test several recently available organic fungicides and the lime sulphur—resin soap spray for mildew control.

Preliminary tests on onion foliage with all the fungicides used showed that with the exception of lime sulphur—resin soap the materials as formulated did not wet the the leaves adequately. However, wetting and coverage of the waxy foliage was greatly improved when either Agral LN or Triton B 1956 proprietary spreaders were added to these fungicides. For this reason these spreaders were tested with each material excepting the lime sulphur—resin soap spray.

Experimental Design and Treatment

For the experiment, six beds of onions (4 rows of plants per bed) were selected from a very uniform stand in a late October field planting. Plots were two beds in width and 12 links in length and contained about 250 plants. The experiment was of random block design with three replications of each treatment. All sprays were applied with a knapsack spray (Fig. 3). Unsprayed buffer plants were left between treatment plots to encourage mildew development.

Spray strengths of the various fungicides used are listed in the table below:—

TABLE 1.

Treatment.	Strength of Spray. 100 Gallons Water.
Copper oxychloride	3⅓ lb.
Thiram	1½ lb.
Ziram	1½ lb.
Zineb	1½ lb.
TZU-4311*	1½ lb.
Captan	2 lb.
Lime sulphur—resin soap	1% of each.

* TZU-4311 is an experimental fungicide having the composition 40 per cent. thiram, 20 per cent. ziram, 20 per cent. tetramethyl-dithiocarbamine-acid-methyl-arsine and remainder inert material.

The Agral LN and Triton B1956 spreaders were used with each of the materials listed above, excepting the lime sulphur—resin soap mixture at the rate of 6 fluid ounces in 100 gallons of spray.

Five spray applications were made to the plots at approximately ten day intervals, commencing on November 11, three weeks after the onions had been planted out from the seedbed.

Disease Development.

Although no detailed assessments were made mildew developed throughout all experimental plots but was not as severe as in adjacent earlier planted crops on the same property.

Fig. 3.—View of onion experimental plots at Spearwood, showing a test fungicide being applied by knapsack spray for mildew control.

Fig. 4.—Downy mildew fungicidal spray experiment at Spearwood. View of harvested plots showing matured bulbs placed in boxes for curing.

Plot Records.

All plots were harvested at maturity on January 19, and after curing for a fortnight (Fig. 4) the onions were topped, graded and weighed.

The following table gives the total yields in lb. for the various treatments:—

TABLE 2.

Treatment.	Yields of Cured Onions (Average of 3 Plots.) lb.
1. Control—unsprayed	51.3
2. Copper oxychloride + Agral	50.7
3. Copper oxychloride + Triton	53
4. Thiram + Agral	44
5. Thiram + Triton	48
6. Ziram + Agral	52
7. Ziram + Triton	57.3
8. Zineb + Agral	62.3
9. Zineb + Triton	65
10. TZU-4311 + Agral	45
11. TZU-4311 + Triton	55.3
12. Captan + Agral	53.3
13. Captan + Triton	49.3
14. Lime sulphur—Resin soap	50.7
Least significant difference 5% level	8.7
Least significant difference 1% level	11.8

Discussion.

Of all the sprays tested, zineb was the only fungicide which gave significantly higher yields of onions than the control.

Both the Agral LN and Triton B1956 spreaders proved satisfactory with each spray in giving good coverage of the leaves.

The disease developed very rapidly in the experimental plots during the early stages of crop growth. At this time the zineb sprayed plants had noticeably less blighting of the foliage due to mildew attack than plants in any other treatment and were also more vigorous. Subsequently further disease development was checked by unsuitable weather conditions and at harvest time the differences observed earlier were much less noticeable. However, the yield increases obtained in plots sprayed with zineb were considered due, in part at least, to mildew control.

As the disease this season was not as serious as normally experienced it is planned to conduct further tests next season using earlier planted crops grown when conditions are generally more favourable for mildew development.

RECOMMENDATIONS

As control of mildew is very difficult to achieve once the disease has become established in a crop, prevention must be aimed at rather than cure.

The following measures are therefore recommended for the control of this disease:—

1. Sanitation.

As the fungus can persist from season to season in crop remains, all dead leaves and discarded bulbs should be burnt after harvesting has been completed.

2. Rotation.

To prevent infection of seedlings and field crops from diseased refuse in the soil, a rotation should be adopted so that onions are not grown on the same land more frequently than once every three years.

3. Spraying.

From the results obtained in this season's experiment, it is tentatively recommended that where downy mildew is troublesome on onions a zineb spray be tried both on field crops and on onions grown for seed production. The material should be applied at a strength of 1½ lb. in 100 gallons of water. To ensure good coverage an efficient spreader such as Triton B1956 or Agral LN should be added to the spray at the rate of 4 to 6 fluid ounces in 100 gallons.

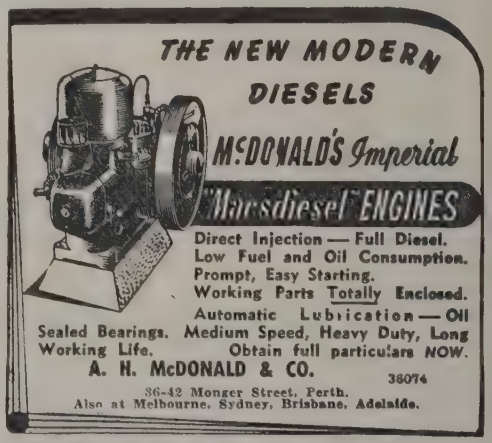
Spraying should commence before mildew develops and continue at 10-14 day intervals depending on weather conditions.

Zineb is marketed under such trade names as Dithane Z-78, Zebtox, Zineb 65, etc.

ACKNOWLEDGMENTS

Grateful appreciation is expressed to Mr. Rudan of Spearwood for making land and facilties available for the experiment.

Thanks are also due to officers of the Vegetable Branch in this Department for their assistance in applying the sprays and harvesting the onion plots.



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DOUBLEGEE

(*Emex australis* Steinh.)

Introduced from South Africa as a vegetable in the early days of settlement, doublegee now occurs in most parts of the State. Besides causing injury to the hooves of animals it competes vigorously with crops and is difficult to control.

WEEDS of Western Australia

By **G.R.W. MEADLY** M. Sc.
Officer in Charge, Weeds and Seeds Branch

DOUBLEGEE

(*Emex australis* Steinh.)

THERE is no more troublesome weed in Western Australia than doublegee. Besides its competitive and smothering effect on crop and pasture, the spiny fruits penetrate the hoofs of stock causing lameness. It is a quick-growing annual which soon produces a strong taproot and forms seeds at an early stage of growth. Dormant seeds will continue to germinate for a number of years and a succession of germinations often occur in the one season. The seedlings are capable of surviving adverse conditions and making rapid recovery.

Doublegee, like a number of other serious weeds, is native to South Africa and was introduced to this State during the first years of settlement. An article in the Sydney Morning Herald of December 7, 1912, read as follows—"In 1830 the ship Margaret left Bristol, England, with passengers for the Swan River Settlement and during the voyage called at Cape Town, where one of the intending settlers procured some seeds of the so-called Cape spinach, a plant known to botanists as *Emex australis*, with the view of cultivating it in the land of his adoption. In due course the seeds were sown in a garden and the resulting plants grew vigorously but instead of being a useful and palatable vegetable it has proved to be one of the most obnoxious weeds ever acclimatised in Western Australia."

At first the plant spread mostly in the coastal areas near Geraldton, later extending to the Murchison and Gascoyne and eventually to the Kimberleys. It is now widespread in the pastoral areas and is also a serious pest in many parts of the wheatbelt besides causing concern in portions of the South-West. In the North-West it is mainly located along the rivers, but farther south has a more general distribution. Although growing most vigorously on heavy soils it is by no means restricted to them.

Until about 1870, doublegee was not recorded from any other State, but it then appeared in South Australia where it is known as "spiny Emex" or "three-cornered jack." It was later recorded in Victoria and New South Wales and was reported from Queensland in 1911.

DESCRIPTION

The name doublegee is derived from dubbeltge-doorn, the Afrikaan for devil's thorn, an appropriate title.

It is a vigorous, spreading annual with rather fleshy prostrate or ascending stems up to several feet in length and a long, thick taproot. The leaf blades, mainly two to three inches long, range from oval to triangular in shape and are on stalks of about the same length. The flowers are inconspicuous, but the fruits are very distinctive. They are woody, one quarter inch long and triangular in cross section and bear three rigid spines. Unless harshly treated the single seed remains enclosed in the fruit. Doublegee is a member of the family *Polygonaceae*, which also includes docks, sorrel and wireweed.

DOUBLEGEE

(Emex australis Steinh.)

Portion of plant showing habit of growth. Subsidiary drawings show details of fruits, flower and seed

(From a pen drawing by C. A. Gardner, Government Botanist.)

SIGNIFICANCE

Doublegee is not known to be poisonous but on the other hand is not relished by stock and usually is only eaten when grazed accidentally along with other herbage. It provides vigorous competition for useful plants and is a problem in cereal crops, especially on the heavier soils. Doublegee is also troublesome in pastures but not to the same extent as on arable land.

Many cases of animals becoming lame and crippled have been caused by the rigid spines of the fruits penetrating their hoofs. The spines are so placed that one can always be expected to be in a vertical position. Such lameness is particularly serious when involving travelling stock and makes animals more vulnerable to the attacks of dogs and foxes. Sheep having soft hoofs after transport by boat are likely to suffer severely as also are young lambs. Doublegees can also be uncomfortable and even dangerous for barefooted children and have been the cause of many punctured bicycle tyres.

CONTROL

Since the original introduction in the early days of settlement, the weed has been spread extensively and there are now few districts in the State where it does not occur. Rubber-tyred vehicles, including aeroplanes, have been important distributing agencies along with stock, hay, chaff, and poorly-graded lines of subterranean clover seed. In clover seed the doublegees themselves may be present, often with the spines broken by the threshing, or sometimes the seeds have been removed from the fruits. The seeds are similar in shape to those of a dock.

Although an annual, doublegee is a particularly difficult weed to control. This is due to several characteristics. The plants seed very freely and the first seeds are formed at an early stage of growth when the plants are comparatively small. Again, the fruits are well-adapted for spreading and the protected seeds retain their vitality for many years.

Where only isolated plants are present, they should be grubbed and, if bearing seeds, destroyed by burning. With large areas, cultural methods provide the most effective means of control. Shallow cultivation in February and March will induce a high percentage of germination with the first winter rains when further cultivation will do much to destroy the seedlings. In the wheatbelt, in cases where doublegee control is the primary objective, a modified crop rotation is then often desirable, embodying for a number of years a two-year rotation of an early variety of wheat alternating with fallow. The use of an early variety allows a cultivation to be made following germination after the first rains. Some farmers favour a three-year rotation—clean fallow, wheat and oats—the oats, for grazing, replacing the pasture year. Such rotations are dictated by the weed infestation and no doubt would not be followed in the absence of doublegees.

The working of the land should be designed to induce germination, and exhaust the supply of seeds in the soil. Deep ploughing is not favoured, as seed buried in this way can be expected to germinate when brought to the surface by subsequent workings, even if these are delayed for a number of years.

In areas where pasture establishment, including ley farming, is possible, the sowing of clovers and grasses, particularly subterranean clover, together with liberal dressings of superphosphate, have checked the growth of doublegee. Farmers prefer to leave heavily-infested land under clover for an extended period before cropping, as germination of the weed is stimulated as soon as the soil is worked.

The hormone-like herbicides have given such spectacular results with wild turnip and wild radish that their use for the control of doublegees is often under discussion. The habit of the plant, and the fact that it is an annual, gave reason to believe that it would be susceptible to moderate rates of application, and trials were commenced by the Department when the chemicals first became available several years ago. Unfortunately the doublegee belied its appearance and results have not been very encouraging.

Farmers have claimed varying degrees of success with use of different 2, 4-D formulations and some of our trials have caused a marked suppression of growth and in some cases a high degree of control. After many detailed investigations ex-

tending over several years, however, we are unable to recommend a treatment that is likely to give consistent results and destroy a high proportion of the plants. This does not mean that in some cases spraying is not warranted in order to reduce the competitive effect of the weed.

Although our work has been largely negative it has answered many questions and the experiments have been described in detail in the Journals of Agriculture July-August 1954 and March-April, 1955.

It is not intended to discontinue experimental work with this weed as there is every chance that a formulation will be produced having a greater lethal effect and penetrating capacity.

Results with Dinoc (30 per cent. sodium dinitro-ortho-cresylate) have already been recorded. A high degree of control of seedling doublegees was obtained by spraying with a solution of Dinoc in water in the proportion of 1:100 by volume. Two pounds of sulphate of ammonia was added to each 100 gallons of solution. In the case of small plants, satisfactory results were obtained with applications of 100 gallons per acre and although cereals were "tipped" to a certain extent no permanent injury was caused.

This method has been used for the control of doublegees in cereal test rows at Research Stations but is scarcely practicable for extensive areas for two reasons. Firstly, the cost of chemical exceeds 30s. per acre and secondly, high volumes must be applied, calling for large quantities of water and making low-volume equipment unsuitable for application.

Other chemicals such as sodium chlorate and arsenic pentoxide can be used for the destruction of small patches of doublegees but are not selective in action and destroy other herbage. One pound of either substance should be dissolved in two gallons of water and applied in the form of a fine spray.

Trials with hormone-like herbicides have been carried out at many centres using different rates of a number of formulations applied by means of ground boom units and aircraft. Within a few days of spraying with these chemicals the doublegee plants usually show formative effects, these being most pronounced in the case of seedlings. The leaves tend to twist and become more erect and a swelling develops at the base of the stem. A splitting of the runners is a characteristic symptom, and the growth of the weed is generally depressed. Malformation and proliferation of floral parts also occurs.

Even with rates as low as 4 oz. acid equivalent per acre some of the smaller plants usually succumb. The degree of effect on the remainder is variable. The growth of some is scarcely interrupted while others, although showing obvious injury, make renewed growth from terminal growing points. Plants affected more severely form shoots from near the base of the stem. Those which recover produce a number of normal viable seeds.

Various formulations of 2, 4-D used at a wide range of acid equivalent levels have not proved consistently effective against doublegees and could not be considered as a means of eradicating this plant or even causing a reduction in regeneration the following year.

The most effective results followed two applications of herbicide within a fortnight. At the Chapman Research Station, Nabawa, complete control was obtained with all double treatments including 6 oz. acid equivalent per acre of 2, 4-D amine. With this trial, however, a high degree of control was obtained with a single treatment of 6oz. acid equivalent of the amine, and the same range of treatments used at Beverley in the same season did not give any significant control.

As with a number of other weeds, somewhat better results have been obtained under crop than under pasture conditions. The spraying of doublegees in a crop, particularly when other susceptible weeds are present, could be an economical undertaking in areas where this weed is vigorous and strongly competitive. Although a high proportion of kill cannot be expected, 6 oz. of acid equivalent per acre of the ester of of 2, 4-D has caused suppression of growth for a period and could result in considerable advantage to the crop if applied when the weeds are small. Doublegees generally have been affected to a greater extent by the ester than by similar quantities of the amine or sodium salt of either 2, 4-D or M.C.P.A.

The volume of solution does not appear to be an important factor, as was suggested at one stage. Reducing the volume from eight to four gallons, applied with a low-volume boom caused no improvement and similar results followed the application of the same quantity of active chemical in two gallons per acre by means of an aircraft.

There is evidence to indicate that treatments are more effective in the northern portions of the wheatbelt, possibly associated with more rapid growth in the early part of the season. This apparent advantage is offset by the fact that, in those districts, doublegees tend to germinate over a longer period.

Chemicals of the growth regulating or hormone-like group are continually being tested for herbicidal properties and it is possible that a formulation will be prepared that will prove effective against doublegees.

Biological control has been considered but there is little hope of success with this method.

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Seed of Neptune and Currie cocksfoot which proved so successful at the Wokalup Research Station, can now be procured by farmers who are prepared to sow for seed production. The original samples used at the Research Station were procured from the C.S.I.R.O. Plant Introduction Division, whose botanist collected seed from the coastal areas of Portugal and Morocco.

Last year, small paddocks were sown in rows in order to augment the supplies of seed to enable some distribution to take place, and also to give a demonstration of a method of seed production.

The Superintendent of Dairying (Mr. M. Cullity) now advises that small parcels can be made available to farmers who are interested in seed production. Successful applicants will be requested to plant the seed in spaced rows to allow inter-row cultivation, and to submit the areas sown for certification under the Departmental scheme. As limited supplies of seed only can be distributed, it is most desirable that applicants have the necessary cultural implements, and can arrange for the harvesting and threshing of the seed.

The maximum quantity of seed cannot be finally determined as yet, but it is unlikely that it will be more than sufficient for sowing five acres at 2 lb. per acre. Seed is priced at £1 per lb. Applications for seed should be addressed to the Superintendent of Dairying.

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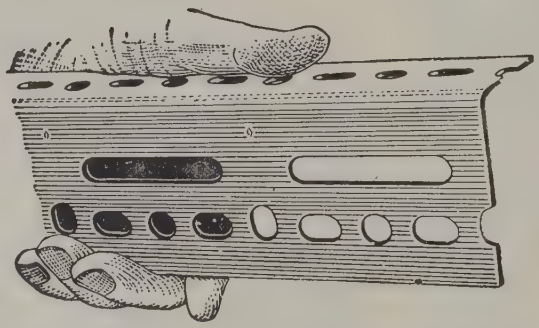

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INSECT Pests AND THEIR CONTROL

By C. F. H. JENKINS, M.A., Government Entomologist

THE LUCERNE FLEA

(Sminthurus viridus L.)

THE lucerne flea or clover springtail is best known in this State as a pest of clover pastures, but various plants, including many types of vegetables, are also liable to attack. The insect is of European origin, being widely distributed over that continent. It occurs also on the north coast of Africa, in the Argentine, and in all the Australian States with the exception of Queensland.

The date of its introduction into Australia is not known, but it was noted in South Australia as early as 1884. It was not until 1910 that the pest was observed in Western Australia, and it is believed that baled fodder imported from South Australia was the medium of introduction.

GENERAL DESCRIPTION

The terms flea and springtail imply that the insect is a good jumper, and this is very true, but the creature is not by any means closely related to the true flea. It does not jump by means of well-developed legs, as does the flea, but with the aid of a special organ known as the spring. Reference to the accompanying illustration will show just how this mechanism works.

The insect is a dumpy-looking creature, wingless and about 1/10th of an inch in length. The colour pattern varies greatly but green or greenish yellow usually predominates. The mouth parts are of the biting type and the plant material is actually chewed and swallowed.

LIFE HISTORY

The eggs are laid in batches in moist situations either on the soil surface or beneath decaying leaves and debris. After being laid the eggs are covered by the female with a fluid consisting largely of excreted soil, and on drying, this coating renders the eggs very difficult to detect.

Fig. 1.—Dorsal view of lucerne flea (After Swan.)

In captivity the female has been noted to lay about 60 eggs to a batch and two batches appear to be the average. Under favourable conditions the eggs hatch after three or four days and a "nymph" emerges, resembling its parents in general appearance, but much smaller. The time required for the nymph to develop fully will vary greatly with weather conditions, but is about a month under normal circumstances. As the active period of this pest is approximately from May to October, it is evident that a number of generations can develop during the season.

When warm, dry conditions arise, the eggs fail to develop. They successfully withstand the heat and desiccation of the summer until the next autumn rains again bring about conditions favourable for hatching to take place.

HABITS

The lucerne flea, like the red-legged earth mite, is very dependent upon moisture and quickly succumbs should hot, dry conditions prevail for any length of time. It is seldom a serious pest in sandy localities, but thrives on heavy and slightly acid soils. The reason for this is probably associated with the insect's habit of eating quantities of soil during its life.

The injury caused by the lucerne flea is quite characteristic; small irregular portions of the leaf may be eaten right away, leaving a ragged hole, or the lower surface of the leaf may be left intact as a whitish film.

Lucerne flea injury is sometimes confused with that caused by the red-legged earth mite, for both pests favour much the same environment and have a preference for seedlings and low-growing, wide-leaved plants, but a careful inspection will soon reveal characteristic differences in the injury caused by each.

The mite is a sap sucker, and so does not actually remove any of the solid plant tissue. No jagged holes will be seen in leaves attacked by the mite, and leaves bleached by the lucerne flea will be almost transparent when held up to the light. The mite-injured leaves, although bleached, still remain opaque.

Although clovers and lucerne are the favourite food plants of the lucerne flea, capeweed is also a very important host plant and often shows severe injury. Vegetables, such as peas, beans and potatoes, grown in close proximity to weedy land supporting a growth of capeweed may be seriously affected.

CONTROL

Cultural Methods.

The advantage of clean cultivation in the establishment of clover or lucerne will be obvious, bearing in mind the wide host range of the pest, and its liking for capeweed. Although it is not always practicable to plant on clean fallow, where this can be done, serious insect infestation can only take place from dirty fence-lines and headlands, and a good stand may be secured before a high insect population can occur. In the case of lucerne, early spring planting is sometimes possible. The "flea" population gradually diminishes with the advance of summer whereas the growing conditions for the lucerne (if moisture is available) become increasingly favourable. By the following winter the plants should be quite well-established and much better able to withstand both lucerne flea and red-legged earth-mite attack than freshly-sprouted seedlings.

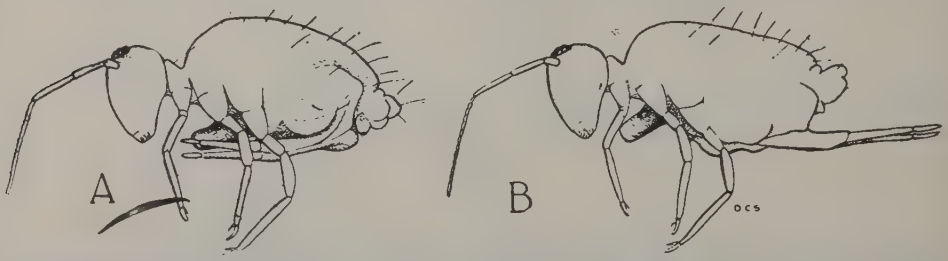

Fig. 2.—Sketches showing the mechanism of the spring. (a) Spring folded under body in the normal position. (b) Spring extended after jumping. The structure projecting from between the middle pair of legs is the base of the ventral tube (adhesive organ). Only the appendages on the near side are shown. (After Swan.)

Biological Control.

A species of predatory mite commonly known as the bdellid mite (*Biscirus lapidarius)* was discovered in this State in 1932 and its main food was found to be the lucerne flea. In permanent pasture lands the mite has shown its ability to exercise a controlling influence on the flea, but it has by no means solved the lucerne flea problem. For many years the mite was distributed by the Department of Agriculture in order to ensure its introduction into the principal clover growing districts. The creature now has a wide range in the lower South-West, and wholesale distribution has been discontinued. The natural spread of the mite is rather slow and some farmers believe in spreading the predators over their paddocks whenever they find a particularly active colony at work. The mite is a little over 1/16th inch in length, reddish in colour, has a long "snout," eight legs and two prominent "feelers."

It has a habit of hiding, particularly during warm spells, under pieces of bark, slats of wood and other suitable cover. Such material and the adhering mites can be collected in a bucket or other receptacle and transferred to areas where the flea is particularly troublesome.

Chemical Control.

The increase in ley farming which has taken place in many districts in recent years has greatly accentuated the problem of both lucerne flea and red-legged earth mite control. The general reduction in fallowing and clean cultivation makes farmers more and more dependent upon chemical treatments to ensure healthy crops. Recently-developed insecticides and the availability of suitable field spraying equipment has revolutionised pest control methods and has made pasture and field crop spraying a really practical proposition. Early recommendations for the chemical control of the lucerne flea depended upon such materials as arsenate of lead and lime sulphur (Jenkins & Forte 1948) but the quantities necessary made such chemicals quite unsuitable for field treatments.

Parathion.

Parathion or E605, sold locally under such trade names as Phosphone 20, Folidol,, Thion 40, etc., has proved outstanding against the lucerne flea and is the present standard method of control. Recent work carried out by the C.S.I.R.O. in Western Australia (Wallace, unpublished information) has shown that parathion applied by a boom spray at 1/16th of a pint of 20 per cent. emulsifiable concentrate (= $\frac{1}{4}$ oz. of active ingredient) per acre will give excellent control and that, although higher concentrations have been used in the past, these are seldom necessary. Where efficient ground spraying is being carried out, therefore, 1/16th of a pint of 20 per cent emulsifiable concentrate could be used. Where some loss may occur from wind drift and evaporation as in aerial spraying, $\frac{1}{8}$ pint of emulsion per acre is recommended.

Unfortunately the residual effect of parathion is very slight, and fleas hatching after treatment will be unaffected. The timing of the spray, therefore, becomes important, and treatments should be applied so as to kill the first brood before egg-laying has commenced. Such an application should normally be made about three weeks after the opening rains. If for any reason the early spray is not possible or has been wrongly timed and lucerne fleas are particularly troublesome, then two parathion treatments should be given about three weeks apart. The second treatment should kill fleas hatching from eggs unaffected by the first spray.

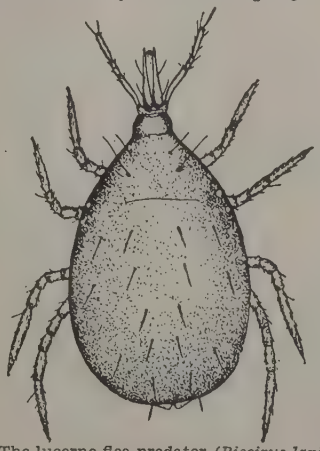

Fig. 3.—The lucerne flea predator *(Biscirus lapidarius).*

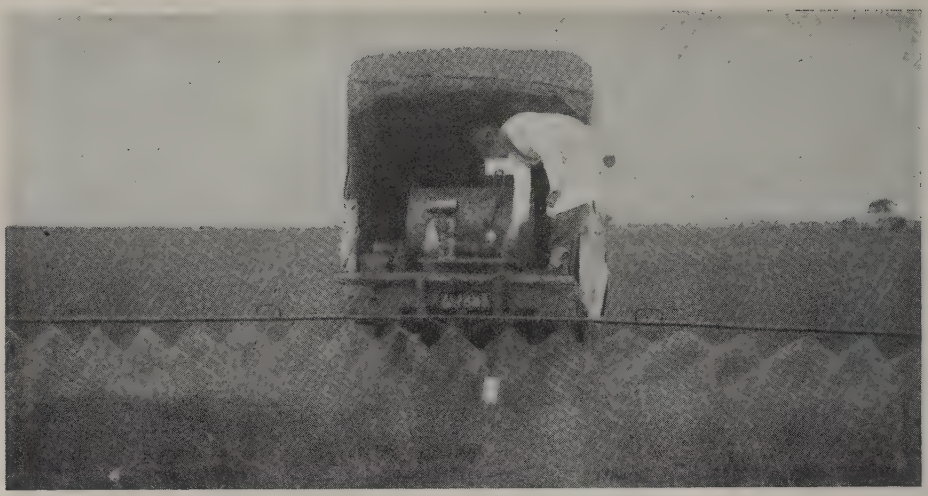

Fig. 4.—The low-volume boom spray, one model of which is shown here, has revolutionised pest control methods and provides effective control over lucerne flea.

Other New Inseticides.

DDT has proved quite useless against the lucerne flea and indeed its application may increase the flea population due to the toxic effect on the bdellid mite (Wallace 1954 *a*).

Benzene-hexachloride (BHC or "Gammexane") gave some promise in early experiments (Jenkins & Forte 1948) and (Swan & Lower 1951) but subsequent work has shown it to be of little practical use (Wallace 1954 *b*) especially in view of the remarkable effectiveness of parathion.

Lindane spray at 1.1 and 2.3 ozs. per acre gave no control of the lucerne flea but fair control of the earth mite. The latter, however, was in no way comparable to the DDT treatment either in early or residual effect. (Wallace, unpublished information).

Dieldrin at 4 and 8 ozs. active ingredient per acre applied by boom spray was not effective against earth mites and gave a slight but unsatisfactory control of the lucerne flea. (Wallace, unpublished information).

Combined Spray for Lucerne Flea and Red-legged Earth Mite.

The lucerne flea and the red-legged earth mite are very commonly associated in clover pastures and action to control both pests is often necessary.

Unfortunately parathion is of little use against the red-legged earth mite (Wallace 1954 *b*) and DDT will not control the lucerne flea, but a suitable combination of these chemicals can be used to control both pests.

The dual purpose formula which is recommended is $\frac{1}{4}$ lb of DDT and $\frac{1}{4}$ oz. of parathion per acre. This means that when proprietary 20 per cent. emulsions of the chemicals are used, it will be necessary to apply 1 pint of DDT emulsion, together with 1/16th of a pint of parathion per acre. When stronger or weaker proprietary preparations are used, the quantity should be decreased or increased proportionately. As pointed out under the heading of parathion, when any loss by wind drift or evaporation is likely the concentration of parathion should be increased to $\frac{1}{8}$ pint of 20 per cent. emulsion per acre.

Method and Time of Application.

Low volume boom sprays and aircraft have been effectively used to apply materials for lucerne flea and red-legged earth mite control. As already stated, if one spray treatment only is contemplated it must be carefully timed to kill the newly hatched fleas before egg-laying has commenced. The residual action of the DDT against red-legged earth mite makes the

timing less important with regard to that pest. When the first spray has been delayed or wrongly timed with regard to lucerne flea, a second treatment three weeks after the first may be necessary to control a bad outbreak. The spray should be carefully applied so that patches are not missed here and there in the pastures. Fleas will soon spread out from such places and quickly re-infest sprayed areas. The amount of liquid applied per acre will depend upon the type of equipment used. Aerial treatments with about 2 gallons of spray per acre have proved satisfactory, but with ground equipment from 5-10 gallons per acre are usually applied. The performance of any spray outfit should be carefully tested before spraying is actually commenced. A 30 foot boom, however, will do about 20 acres per hour at 5 miles per hour.

Necessity for Treatment.

Farmers would be well advised to consider carefully the losses which are caused annually by the lucerne flea and the red-legged earth mite. Regular routine spraying over large areas is not recommended. To assist in the establishment of newly planted legumes and to protect special crops, treatments are well worth while. The detrimental effects of DDT upon the bdellid mite predator of the lucerne flea should be borne in mind, however, and, in the main, insecticides should be applied to areas where actual damage is apparent or expected, and not in a wholesale manner merely as a general preventative measure.

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POULTRY SANITATION

By
L. J. GAFFNEY, B.Sc. (Agric.),
Poultry Adviser

Fig. 1.—Hygienic housing on a large scale

A HIGH percentage of poultry losses are caused by unsanitary conditions. Not all diseases can be eliminated by even the strictest attention to sanitation—but undoubtedly the losses can be substantially reduced.

Poultry-farmers are well aware of the heavy losses in terms of stock and productivity that are caused by poultry parasites and disease organisms. The farmer's best weapon of defence against most poultry diseases is sanitation, but under practical farming conditions it would be unreasonable to expect that all disease infections could be checked by even very strict sanitary measures. For example, sanitation offers no absolute safeguard against such important diseases as fowl pox, and pullorum disease. The fowl pox virus can be introduced into the flock from some distant source of infection by carrier agents such as mosquitoes, while pullorum disease can be passed on to chickens through hatching eggs from carrier birds. There is strong evidence to suspect that the various forms of lymphamotosis (leucosis) can also be transmitted through the egg.

Other poultry diseases such as coccidiosis and worm infestations are best controlled through proper sanitation. Poultry and for that matter, all animals are able to build up a natural resistance against disease if they are given the opportunity to do so. Usually the degree of immunity increases with age, providing the health and vigor of the bird have not been impaired, by a heavy attack at the outset. Hence it is essential to pay strict attention to sanitation during the initial growth stages, as it is then that heavy infection is most harmful to the chicken. It is interesting to note that more recent research on the lymphamotosis group of diseases reveals that the majority of birds become infected when very young chickens, and that after about 12 weeks of age the incidence of infection is very low. In the light of this knowledge, poultrymen can institute positive measures to reduce the incidence of lymphamotosis in their flocks and it should make them more conscious of the importance of rigid sanitation in chicken rearing.

PRINCIPLES OF SANITATION

Poultry sanitation is a term used to denote all those measures which will help to reduce the risk of disease. It covers the provision and maintenance of an environment which offers little or no opportunity for disease germs or harmful organisms to become established; the en-

Fig. 2.—Chicken houses with the attached runs "resting" and bare. Light well-drained soils are preferred

vironment comprises everything with which the birds make contact and includes the atmosphere, poultry buildings, fittings, equipment, floor litter, runs and other birds. One or more of these environmental factors can be a source of disease infection. The environment to which healthy stock are to be introduced can be rendered hygienic by:

(1) Interrupting the life cycle of the disease organism.

(2) Allowing the natural elements of sunlight, dessication and aeration to cleanse the environment.

(3) Using germicides to destroy organisms.

Many parasites and diseases spend part of their life-cycles outside the host body. This period may be spent in a secondary host, as in faeces, in the soil etc. Poultry producers are aided in their efforts to break the cycle of infection by the renewal of stock each year, also by the artificial incubation and brooding of chickens, which ensures that chickens do not come in contact with the parental stock which may be disease-carriers.

INTERRUPTING THE LIFE CYCLE OF THE DISEASE

A common method used to break the disease cycle is by clearing the area of stock and leaving this section idle for some length of time. In this way, the disease is denied contact with its host and the number of disease organisms is reduced. In practice, the usual procedure is to rest the brooder runs and rearing ground during the off-season for chicken rearing and to provide alternative runs for the laying flock. It would be unprofitable to leave large areas of housing accommodation idle for the same length of time particularly when the premises can be quickly rendered free of germs by the application of chemical disinfectants.

Another important measure is the strict segregation of different age groups, particularly during early life. Many instances can be cited of severe outbreaks of coccidiosis and roundworm infestations occurring when successive batches of chickens are run on the same ground or are allowed to intermingle. In such instances, the effectiveness of drugs to combat cocci-

Fig. 3.—The top picture shows the chicken runs lightly tilled. In the lower picture, portion of the rangeland has been tilled and left fallow.

Fig. 4.—Land for chicken runs has been sown to rape

diosis and drenching treatments against roundworms are considerably reduced. Chickens reared under such conditions seldom give a good performance in later life.

Young stock of different ages must be kept separate and they must be given sanitary conditions. These are key points in the rearing of healthy, robust stock.

NATURE'S ROLE IN SANITATION

The natural elements of sunshine, dryness and fresh air are germ-killers that are effective and which can be used in abundance. They play an important part in sterilising the soil and keeping the floor litter in a hygienic condition. Soil and litter are the two main sources of infection with which the poultry farmer has to contend, and if he is to succeed in minimising losses through disease, he must take appropriate steps to prevent the poultry runs and floor litter from becoming over-contaminated. Diseases usually flourish in dank places, which are excluded from sunlight and aeration, such as heavily manured ground sheltered from the sun, shaded areas near drinking vessels and excessively damp litter. Many factors are involved in preventing these conditions, and these should be kept in mind when designing the farm and equipping the poultry buildings. This aspect is treated in more detail in departmental leaflets Nos. 2120 and 2154, and need not be elaborated upon in this article, but it must be clearly understood that the essential requirement for housing poultry under local conditions is to exclude dampness and at the same time allow entrance of adequate sunlight and fresh air into the buildings.

Fig. 5.—Young stock ranging on grassland

Soil Hygiene.

Summer is the best time for allowing the natural elements to destroy disease organisms in the soil of brooder runs, rangeland and poultry yards. Even coccidial oocysts and roundworm eggs which can lie dormant in the soil over long periods, are destroyed by continuous exposure to sun, heat and desiccation.

Procedure.

After all stock has been removed from the ground, all surface trash and manure is raked clear and the bare ground is exposed for several weeks to the summer sun. Before cooler weather approaches, the upper inch or two inches of the soil is broken up and stirred by a suitable implement such as a rotary hoe or hand plough. This allows the purifying action of the sun in conjunction with soil aeration, to sterilise the ground more effectively. The liberal application of water-slaked lime powder to the cultivated land will also be beneficial. The rate of application may vary from 1 to 5 lb. per 100 square

Fig. 6.—Using a stirrup-pump to spray the interior and exterior of a chicken-house with a disinfectant solution

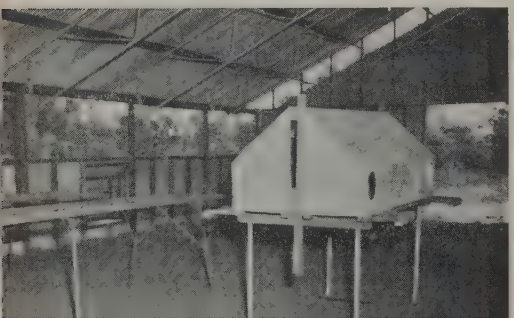
Fig. 7.—Day-old chicks introduced into clean quarters. Rigid sanitation is essential at all times, but particularly when the chicks are young

Fig. 8.—Raised watering places which project outside the shed, prevent litter from becoming damp. Also illustrated (at right) is a mash feeder with wire grids to prevent food being scratched out and contaminated

feet, greater amounts being required where the soil is heavily contaminated. The ground is then left idle until the time arrives for planting to a green crop. The planting of quick-growing green crops such as rape, oats and barley in the brooder runs is delayed until some five to six weeks before the chickens are due, as too tall a growth provides a good harborage for disease organisms. Moreover with rank green feed there is the risk of fibrous material causing gizzard obsructions.

The ground has now been prepared in a hygienic condition and is ready to receive the young chicks.

Fig. 9.—Nests and perches on movable stands will facilitate the cleaning and disinfecting of the laying-house and equipment



Shade Trees.

The question of planting shade trees in the rearing quarters is often raised by farmers. As a general rule, runs adjacent to chicken houses should not be shaded from the sun. If growing stock require summer shade, temporary or moveable shelters can be erected in the yard in close proximity to the poultry house. In some cases, for example where a laneway exists on the rear or the western side of the rearing sheds, deciduous trees can be planted on this side of the houses. By pruning off the lower limbs of the trunk, the upper branches can be trained over to shade the roof of the building. A few flame-trees or other deciduous species planted in the rangeland will provide useful shade to young stock towards the end of the growing season. When it is time to "rest" the range, these trees should be severely pruned so that the ground near the base of the tree is exposed to direct sunlight.

Shade trees are extremely valuable on poultry farms in this State, where high summer temperatures prevail, but forethought in planting is necessary if the trees are not to interfere with farm sanitation.

THE USE OF CHEMICAL DISINFECTANTS

Chemicals can be effectively employed to reduce the incidence of disease in the environment. This mainly applies to the disinfection of poultry buildings, fittings and equipment, but they can also be used as an additional measure to sterilise heavily contaminated ground near poultry houses. The premises are usually disinfected before introducing each new flock of birds. Carbolic and cresol compounds, caustic soda and ammonia solutions are disinfectants which are effective and economical to use. Commercial products containing carbolic and cresol compounds are not expensive and are easy to apply. Caustic and ammonia solutions need to be handled with more caution. A general germicidal solution can be prepared by dissolving 1 lb. commercial lye (containing approximately 90 per cent. caustic soda) and 2½ lb. water-slaked lime in 5½ gallons water. Stirring the mixture will keep the lime in suspension until it eventually dissolves. Spray the floor and all surfaces and joints to a height of approximately two feet from the floor. Chicken runs can be disinfected by saturating the surface inches of soil with water and applying the solution at the rate of ½ to 1 gallon to each square yard. Spraying equipment should be flushed after the treatment. The operator should wear a coat, hat, gloves, goggles and rubber boots for protection when using dangerous chemicals such as caustic soda. Caustic solutions of similar strength to that recommended above may strip paint and corrode galvanised iron and therefore other disinfectants are preferred for sterilising metal feeders, drinking vessels etc.

One other point needs mentioning before completing this review on poultry sanitation. It is sound poultry husbandry to remove ailing and injured birds from the flock as soon as they are observed, as apart from being likely disease carriers, other diseases can be introduced through them into the flock. As an illustration, it is quite common to find sick birds heavily worm-infested, even though the flock generally is practically free of worms. It is advisable to dispose of individual birds that are ailing or in poor condition, for they are seldom profitable even if they do recover. When not in a marketable condition, these birds should be killed and disposed of by burning in some type of incinerator or by deep burying. In some instances, such as chickens affected with coccidiosis, isolation in a pen set aside for this purpose where individual treatment can be applied, will often return them to good health.

By the way, those stray birds which are often seen roaming at will around the farm may be nullifying the entire programme of sanitation. It is well worth while to attend to the fences and gates to ensure that all your birds are securely yarded.

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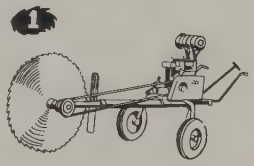

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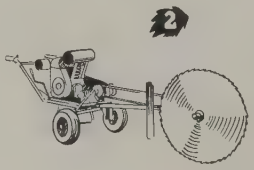

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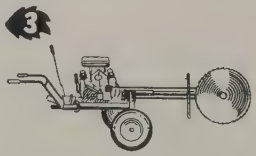

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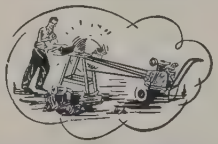

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Fig. 1.—Ruby Red peach trees—1953; (left), sprayed with 1-40 DNC dormant oil; (right), unsprayed. Earlier blossoming and fruit set supported by vigorous leaf development were notable features of the sprayed trees

DNC OIL SPRAYS FOR DECIDUOUS FRUITS

By F. MELVILLE, B.Sc. (Agric.), Senior Horticultural Adviser, and
S. E. HARDISTY, B.Sc. (Agric.), Horticultural Adviser

THE climate of any particular place plays a very important part in determining the kinds and varieties of fruits which can be successfully grown, and one of the most common manifestations of unfavourable weather conditions in deciduous fruits is a condition usually termed "delayed foliation." It is characterised by delayed and irregular blossoming and foliation, failure of many fruit and leaf buds to open and shedding of blossom buds.

All varieties of apples and certain varieties of peaches, nectarines and apricots grown under mild conditions may be affected, while in relatively cold situations these fruits may also suffer after very mild winters.

WINTER CHILLING

Deciduous fruits require a period of chilling during the winter months before the dormant buds will burst into life the following spring. Almonds, most varieties of plums and early peaches and apricots have very moderate requirements and the climate in all the main fruit-growing districts of Western Australia is sufficiently cold in winter to produce normal budburst with these fruits in spring.

Apples require the greatest amount of winter cold and cannot be grown successfully on the coastal plain nor in the Hills areas except in cold pockets. In southern districts such as Donnybrook, Capel, and Albany, where apples are grown at low elevations near the coast evidence of lack of winter chilling can also be seen.

Peaches exhibit great variability in their reaction to climatic conditions. Briggs Red May for instance is not grown commercially because its chilling requirements cannot normally be met in the stone fruit districts. Varieties such as Anzac, Ruby Red, Triumph and Elberta are more tolerant, but are still subject to delayed foliation in milder situations. Early peaches such as Dunhelm and Edward VII will however grow well under moderate winter conditions in such areas as the Swan Valley and foothills.

Each variety has a fairly definite chilling requirement which must be met before the winter rest period is broken. In other words there must be a certain total period measured in days or hours during the winter months when the temperature remains below a critical level.

In certain parts of South Africa it has been found that the critical level is a mean monthly temperature of 54°F during June and July. In California it is considered that 1,000 hours below 45°F or a critical mean temperature for June and July of 49.5°F is necessary.

However complete reliance should not be placed on the measurements of winter chilling in this manner as varietal differences and growing conditions preceding the winter period are also important. Cloudy or foggy conditions by impeding the passage of the sun's rays, not only reduce air temperatures, but also minimise the heating of the buds which is what matters. On clear sunny days the buds may reach a temperature considerably above that of the surrounding air and a difference of up to 20°F has been recorded elsewhere. Atmospheric temperatures can therefore be misleading where much sunny weather is experienced during the winter months, particularly June and July.

The morning fogs at Bridgetown may therefore be of considerable value to apple orchards in the area as they are in the San Joacquin Valley of California. Records available in this State as shown in Table 1 indicate that winter temperatures in most fruit districts are considerably above the limits suggested for California and run very close to the critical level found in South Africa. It is surprising therefore that the effects of delayed foliation are not more marked. Probably the effect is more widespread than realised and particularly in the apple districts trees would probably respond to treatment in most years. However only in certain years are the symptoms very obvious.

TABLE 1.

Mean Monthly Temperatures at Various Centres.

	Degrees Fahrenheit.	
	June.	July.
Perth	57.1	55.4
Kalamunda	55.1	53.2
Donnybrook	52.8	51.3
Bridgetown	51.2	49.7
Manjimup	51.3	49.6
Mount Barker	51.3	49.7
Albany	55	53.6

The mean monthly temperature is calculated from the maximum and minimum daily temperatures.

In 1948 and again in 1949 apple trees throughout most of the fruit growing districts exhibited very pronounced delayed foliation. Blossoming was erratic and flowers were still opening when the earlier settings were well grown. A number of stone fruit varieties was also affected. Since then the trouble has been present to a lesser degree and in 1954 budburst was more normal than it has been for many years.

OTHER FACTORS AFFECTING DELAYED FOLIATION

The degree of delayed foliation depends upon the interaction of a number of factors all associated in some way with the rest period and the amount of winter chilling. The lateness of summer vegetative growth and its effect on delaying the onset of leaf fall and dormancy are of considerable importance. Trees which grow late in the summer thus delaying the commencement of the rest period are much more liable to the trouble. The hot dry summer experienced in this State may therefore be of value in promoting early maturity of the buds. The budburst in the 1954 season was more normal than for many years, and this can be related to the autumn conditions of that year. Leaf fall occurred early, rainfall was below average until mid-April, minimum temperatures were lower than normal, and frosts were reported more frequently than usual during March, April and May.

The spring weather following bud swell will influence the rate of growth and therefore the effects of delayed foliation. The retarded growth of some varieties due to cold spring weather will accentuate the trouble while with a warm spring following a sufficiently cold winter, growth will be more normal. The good blossoming and leaf development in 1954 resulted from ideal autumn and winter conditions followed by warm weather in August and September. Delayed foliation will be worse in years when the trees are late going dormant, the winter is mild with an abnormal number of sunny days and is followed by a cool spring.

Fig. 2.—Granny Smith apple trees—1953; (left), sprayed with 1-20 DNC dormant oil; (right), unsprayed. The early development of large healthy leaves was associated with advanced concentrated blossoming on the sprayed trees

BLOSSOMING

Delayed foliation or prolonged rest affects fruit trees in various ways. Blossoming is delayed and extended over an abnormally long period. For instance, apples which under ideal conditions would complete flowering in two to three weeks may straggle on for six weeks or more. All varieties are not affected alike and cross-pollination may therefore be defective. Thus the setting is erratic, and a large variation occurs in the size of the young fruit. Late blossoms often fail to set and those that do produce fruit of later maturity.

In stone fruits there is a slight delay in the opening of blossoms, but there is not the same extension of the blossoming period as with apples. However in certain varieties, shedding of flower buds a short time before budburst is common. Spinks peaches are notably susceptible, and often Goldmine nectarines and certain apricots are affected. The pruning of such varieties is therefore often delayed until blossoming, when the extent of shedding is apparent, or else the trees are left almost unpruned.

FOLIAGE

Leaf buds require a greater degree of chilling and are therefore always more affected by mild winters. They open very late and a large proportion may fail to burst at all. This results in a serious lack of foliage to sustain the young fruit which suffer accordingly. The lack of leaf cover also renders the bark of the main limbs liable to sunburn and serious damage may occur to peach trees from this cause.

On leaders and strong growth of apples, often only a few buds towards the tip of the shoot will grow leaving the rest of the stem bare. This restricts spur development and may create difficulties in the training of young trees.

With peaches, in severe cases no shoot development at all occurs from pruned leaders while many laterals may produce

only a terminal growth. Apart from the lack of supporting leaves for the young fruit the regeneration of fruiting wood for the following season is inadequate.

At a later date, buds situated on older wood grow strongly to produce numbers of water shoots. By mid-December the trees appear normal but on close examination it is found that the crop is deficient and there is a dearth of suitably placed new fruiting wood.

The overall effect of delayed foliation is to reduce the yield of fruit, firstly by restricting the setting, secondly by affecting the size of the fruit and thirdly by limiting the fruit-bearing surface of the tree.

MEANS OF MINIMISING DAMAGE

There are several ways of minimising the effects of delayed foliation. The choice of non-susceptible varieties and planting in an area where climatic conditions are suitable are of course the most satisfactory means of overcoming the difficulty. Management methods which restrict late summer growth will also assist. However these methods are often not entirely practicable and it is necessary to use artificial means of treatment where conditions are not ideal.

It has long been observed that oil sprays applied as ovicides or scalicides have a beneficial effect on budburst. However the effective period of application is short and variable from year to year. More recently it has been found that the addition of dinitro ortho cresol (DNC) to the dormant oil not only gives added effect but also increases the period during which the spray may be applied.

Field investigations of the value of DNC oil sprays on Ruby Red peaches and Granny Smith apples have been carried out for the past three years, while last year spot treatments of a number of other deciduous fruits were made. The results have demonstrated that these sprays are beneficial on the varieties in question but the magnitude of the effect will vary from year to year. The work was carried out in the Hills districts near Perth, but the findings are applicable to much of the fruit growing areas.

Ruby Red Peaches.

The Ruby Red is grown extensively in Hills orchards and is a valuable peach on the local market because of its attractiveness and excellent handling properties. Reasonable crops are obtained, but yields are variable from year to year. Low yields are usually associated with delayed foliation as the results of the investigations have shown. For instance in 1952 and 1953 when delayed foliation was quite marked, DNC oil sprays produced very definite results. In 1954, which was a particularly good year for budburst, the difference between sprayed and unsprayed trees was much less apparent.

In 1952, 12 trees were sprayed with a mixture consisting of one part of a pre-emulsified winter oil containing 2.5 per cent. dinitro ortho cresol to 39 parts of water. The spray was applied during the second week of August, that is approximately six weeks prior to budburst. A further 12 trees received a straight oil spray and 12 unsprayed trees were left as controls. In 1953 and 1954 the oil spray was omitted and 24 trees were used in each of these years for the DNC oil treatment.

The blossoming of DNC oil sprayed trees was profuse and concentrated into a relatively short period. Full blossom was approximately ten days ahead of unsprayed trees which continued with straggly blossom some time after sprayed trees were well in leaf. Leafage followed rapidly on blossoming so that the young fruits were being well supported by large healthy-coloured leaves by the time they started to develop. The foliage on unsprayed trees was very retarded (Fig. 1) and not until mid-December did the trees develop normal appearance. The straight dormant oil spray advanced blossoming slightly but had little effect on leaf buds.

DNC has fungicidal properties and in 1952 it was noted that trees sprayed with this material appeared less infected with Peach Leaf Curl. 1953 was a particularly bad year for this disease and the difference between DNC treated and untreated trees was very evident even though rountine copper sprays were applied throughout by the grower. It seems possible that apart from any fungicidal value of DNC the earliness of leaf development may be a factor

in reducing infection by this disease. Heavy leaf drop occurred on the control trees due to leaf curl and this would have a decided influence on the final crop.

A record of fruit removed in thinning in 1953 showed that an average of 141 fruits was removed from DNC oil sprayed trees and 29 fruits per tree from the control. Many of the latter trees were carrying very poor crops and required practically no thinning. At harvest the average yield from sprayed trees was 2.75 bushels as against 1.5 bushels from unsprayed trees. The range of sizes on both treatments was very similar, in other words sprayed trees carried almost twice as many fruits of the same size as the controls. They also ripened a few days earlier. 1953 was generally a light year for the Ruby Red variety.

In 1954 the beneficial effects of early blossoming and leaf development were noted but subsequently little differences could be seen mainly because control trees had set heavy crops following the very light crops of the year before. No attempt was therefore made to compare the yields at harvest time.

Granny Smith Apples.

Granny Smiths grow and crop very well under Western Australian conditions but, in certain years and in particular in milder situations, there is a reduction in crop which may be attributed to the effects of delayed foliation. Beneficial results of DNC oil sprays on apples were reported from Palestine some years ago, and it was thought that certain apple varieties in this State, notably Granny Smiths and Jonathans, might respond to this treatment.

In 1952, ten Granny Smith trees situated in a Hills orchard were sprayed with DNC oil and an equivalent block was left unsprayed. This work was repeated in 1953 with the inclusion of a straight dormant oil treatment and a similar set of treatments were set up on another orchard. In 1954, treatments on the second block were repeated. Spray treatments consisted of 1 part of DNC oil to 19 parts of water and 1 in 20 straight dormant oil. These were applied at the end of August except in a few instances where later sprays were tried.

In 1952 and 1953, marked benefits were obtained. However in 1954, owing to the favourable season, there was no clear-cut difference between sprayed trees and controls. The following remarks therefore apply mainly to the former two seasons.

Spurburst of DNC oil sprayed trees was uniform and at least a week earlier than unsprayed trees. Leaf development was very rapid; blossoming was also well ahead and confined to a much shorter period than unsprayed trees which straggled on for weeks. Fruit set was complete and a healthy coverage of leaves had formed by the time the unsprayed trees reached full blossom with only poor leaf development. Not only were the leaves of sprayed trees larger and more plentiful but they were distinctly greener in colour. Fig. 2 illustrates the difference in the appearance of trees in the two treatments. Trees sprayed with straight dormant oil without DNC were at all stages better than unsprayed trees but never equal to the DNC treatment. The initial gain obtained by the latter trees was more than maintained during the growing period. Besides the large even size of the young fruit and increased shoot growth, the general health of the trees was far superior. In contrast, fruit on unsprayed trees was generally backward and very uneven in size.

At harvest the crop from DNC treatments was considerably greater than that from either unsprayed or straight oil sprayed trees, as shown by the following yield figures.

Year.	Treatment.					
	DNC Oil Spray.		Dormant Oil Spray.		Unsprayed.	
	Average No. of fruits per tree.	Average Bushels per tree.	Average No of fruits per tree.	Average Bushels per tree.	Average No. of fruits per tree.	Average Bushels per tree.
1952	959	5·8	....	....	687	4·0
1953—						
Block A	830	5·25	545	3·8	136	1·4
Block B	1,241	7·6	948	6·0	725	5·2

The large increase in harvested fruit resulting from DNC oil sprays illustrates the commercial value of the treatment.

Fig. 3.—Three-year-old Granny Smith—1953; (left), sprayed with 1-20 DNC dormant oil; (right), unsprayed. The percentage of buds breaking dormancy was greater, and leafage was earlier and more vigorous on the sprayed tree

The main influence of DNC oil on the crop was to increase the number of fruit. In each year, DNC trees carried many more fruits than either straight oil treatments or control trees. Nevertheless practically all the fruit reached commercial size. Fruit on DNC trees was almost the same average size as on straight oil trees but somewhat smaller than on the controls. On light crop unsprayed trees, the apples were oversize.

Other Varieties of Apples.

A number of other varieties of apples were spot sprayed during 1954 to determine their reaction to DNC oil spray.

As this was a favourable season, effects were less than they might otherwise have been. Nevertheless, some useful indications were obtained. Rome Beauty, Yates, Golden Delicious and Doughertys responded very well to treatment. Even, early spurburst, with a good development of leaves prior to a concentrated blossoming were notable features with these varieties. Jonathans, Delicious and Dunns showed less benefit, but still responded slightly and in a less favourable year would probably give greater comparison. Jonathans have been tried in previous years but effects have not been as spectacular as with Granny Smiths. A most important feature with all DNC treated trees was the uniformly good size of the young fruit. This is particularly important with Yates as the initial size advantage is maintained in the mature fruit.

Bartlett Pears.

A DNC spray was applied to Bartletts in mid-August which is considered to be too late for optimum effect during a season such as the past. However spur burst was advanced by the treatment and leaf size at blossoming was considerably greater than on unsprayed trees.

Other Stone Fruit Varieties.

Initial responses were obtained with Elberta, Triumph and Carmen peaches and President plums and some benefit can be expected with these varieties. Further

work is necessary to determine the optimum time of application but it appears that late July would be suitable.

Young Trees.

A further interesting effect of DNC oil was noted on young Granny Smith apple trees. Three-year-old trees sprayed at the end of August with 1 in 20 strength DNC oil produced much earlier leaf development. This is well illustrated in Fig 3, which shows similar sprayed and unsprayed trees photographed on the same day. Apart from earlier leafage, a greater percentage of buds burst on the leaders of sprayed trees than either unsprayed trees or others where the dormant buds had been notched. Greater leader extension and shoot growth also resulted. This development of buds which otherwise would remain dormant should be of assistance in the training of young trees.

CONCLUSION

From a study of the climatic conditions and their effect on the growth of deciduous fruits it appears that a definite problem of delayed foliation exists in many of the fruit-growing districts of this State. This is substantiated by the reaction of certain varieties to dormant sprays on DNC oil and it is considered that a worthwhile response could be obtained on these and possibly other varieties over a wide area. In many instances the symptoms may not be obvious, but nevertheless there is an insidious effect which would respond to DNC oil sprays.

In particular, Granny Smiths have been tested and outstanding results have been obtained, but other apple varieties can also be expected to benefit materially. In certain years, overcropping may result but this would allow for selective thinning, thus improving the final quality. It is possible that the difficulties associated with cropping of the Bartlett pear, which in the Hills districts necessitates the retention of untipped laterals, may also be partly alleviated by this type of treatment. The ready application of the method to pome fruits lies in the fact that the spray is simply a dormant winter oil with DNC as an additive. Its use does not entail extra cost or the application of an extra spray.

Peaches have responded well to DNC sprays and to date no damage has been seen. However, in view of the reports of oil damage to certain varieties in South Africa, DNC sprays should not be used at a strength greater than 1 part in 40. For other fruits, however, 1 in 20 mixtures are suggested as this conforms to the recommendations for dormant oil sprays. However on Granny Smith apples little if any, difference was noted between 1 in 20 and 1 in 40 mixtures.

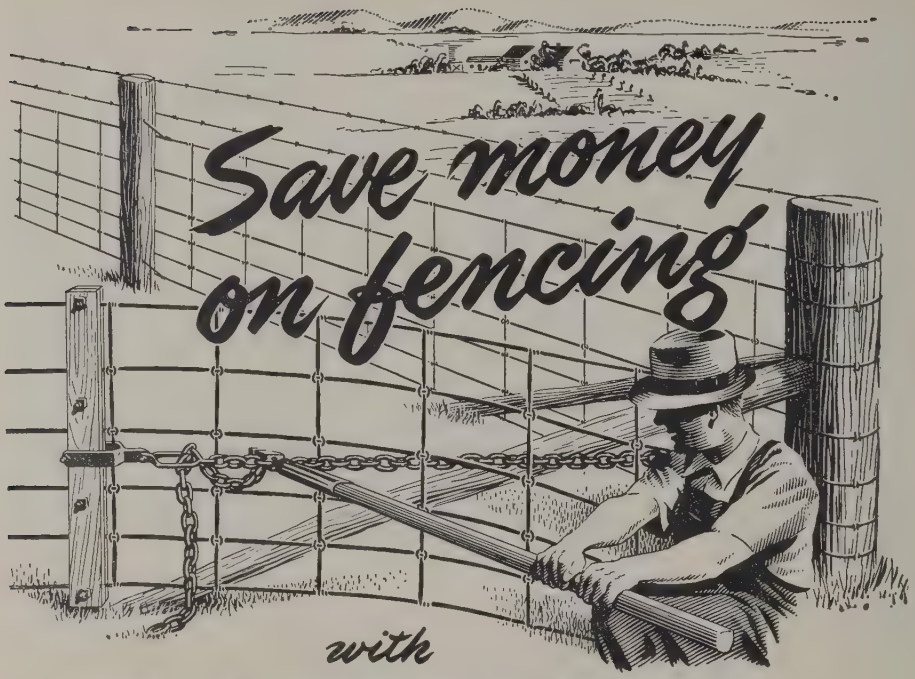
There is some latitude in the time of application of DNC oil sprays but late applications, that is, less than six weeks prior to blossoming should be avoided. On the other hand it is not desirable to spray peaches earlier than mid-July, nor apples before the end of July. More information is needed on this aspect before optimum times can be definitely stated.

DNC oil mixtures have been used elsewhere for many years, but only recently has attention been focused on their usefulness in this State. DNC is a yellow dyestuff which has a number of uses in the horticultural field. Apart from its physiological effects, on budburst, it is a selective weedicide, an ovicide for mites, a scalicide and fungicide. Some damage to cover crops and annual plants around sprayed trees can be expected but this is of little importance. Detailed observations were not made during the investigations of the insecticidal value of DNC, but no obvious differences were noted between straight dormant oil and DNC oil sprays with regard to Bryobia mite and San José Scale. Both these pests did, however, build up on unsprayed trees.

The spray material is sold under several different trade names such as Shell DNC Universal Winter Spray, Capsine and Lanes DNC Winter Spray Oil.

ACKNOWLEDGMENT

Grateful acknowledgment is made of the assistance given by various growers, viz. Messrs, O. E. and L. C. Owen, H. and S. Littlely, C. E. Davey and O. Bodinnar, who made suitable blocks of trees available, also to the various officers of the Horticultural Branch who assisted and to Mr. C. Balmer, Government Photographer, who was responsible for the photographs.



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GENERAL

ADVANCES IN AGRICULTURE: proceedings of conference of agricultural scientists—Perth, Feb. 23rd-Mar. 6th, 1953. Australian Institute of Agricultural Science. Western Australian Branch. Perth [1953].

YEAR BOOKS OF AGRICULTURAL CO-OPERATION, 1950-1953. Oxford, 1950-1953.

FARM MANAGEMENT

THE BOOK OF THE FORDSON TRACTOR, by S. Abbey, Lond., 1954.

ENGINEERING FOR AGRICULTURAL DRAINAGE, by H. B. Roe and Q. C. Ayres. N.Y., 1954.

GREEN FIELDS AND PASTURES NEW, by J. E. Hodge. 2nd ed. Adel. [1954].

SOIL AND CROP MANAGEMENT

INSECT, FUNGUS AND WEED CONTROL, by E. R. De Ong. Lond. [1954].

PLANT BREEDING FOR EVERYONE, by J. Y. Beaty. Boston, 1954.

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THE PROFITABLE CULTURE OF VEGETABLES FOR MARKET-GARDENERS, SMALL-HOLDERS AND OTHERS, by T. Smith. 3rd ed. Lond., 1954.

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BETTER PRUNING OF FRUIT, by N. Stewart. Lond., 1955.

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LIVESTOCK

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HEN BATTERY MANAGEMENT, by P. A. Prall. Lond., 1954.

LIVESTOCK MARKETING, by A. A. Dowell and K. Bjorka. N.Y., 1941.

PIGS, FROM CAVE TO CORN BELT, by C. W. Towne and E. N. WENTWORTH. Norman, Oklahoma, 1950.

PRINCIPLES AND METHODS OF ANIMAL BREEDING, by R. B. Kelley. 2nd ed. Syd., 1949.

PRINCIPLES OF VETERINARY SCIENCE, by F. B. Hadley. 5th ed. Philadelphia, 1954.

THE WESTERN RANGE LIVESTOCK INDUSTRY, by M. Clawson. N.Y., 1950.

NATIONAL INSTITUTE OF AGRICULTURAL ENGINEERING—TEST REPORTS

A complete set of the above Test Reports on a wide range of agricultural machinery is now in stock. In all nearly 150 machines including tractors, combine harvesters, seed drills, knapsack sprayers, ploughs, etc., etc., have been tested within the last five years. The type of test naturally varies with different types of machines, but most test reports contain a brief specification of the machine; principal dimensions and technical data, output, etc.; a detail of the test applied and the results including fuel consumption, etc., together with notes on the general suitability of the machine for its purpose, faults observed and so on. The Reports are, of course, authoritative and unbiassed.

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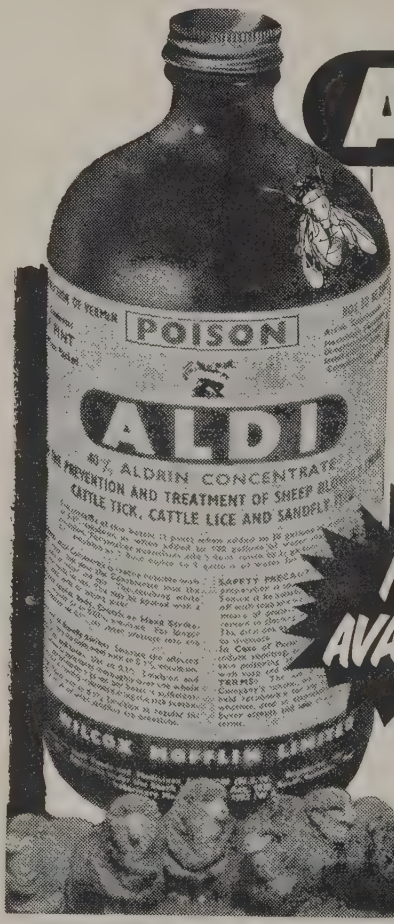

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RESTRICTIONS ON THE MOVEMENT OF FRUIT

A Factor in Fruit Fly Control

"I LIVE at Armadale and I'd like to send a case of home-grown apples to my niece in Bruce Rock. Is this permitted?" That is the sort of question that officers of the Horticultural Division are asked many times every year. Most people are aware that there are certain restrictions on the movement of fruit in this State, but they have only a hazy idea of the details.

Those details are set down at length in the official regulations, copies of which are available from the Department of Agriculture, Perth, but in this article an attempt is made to outline the regulations briefly in layman's language.

REASONS FOR THE RESTRICTIONS

The Mediterranean fruit fly (*Ceratitis capitata*) is an orchard pest that is found in most of the fruitgrowing countries of the world, and unfortunately it was introduced into Western Australia when our fruitgrowing industry was in its infancy.

In this State, the fly has been recorded as far north as Carnarvon, as far east as Kalgoorlie and as far south as Albany and Esperance, but fortunately it has only become firmly established over a much smaller area.

Obviously, the indiscriminate distribution of fruit from badly-infested areas could facilitate the spread of the pest, and certain restrictions were brought into being, under the provisions of the Plant Diseases Act, to control fruit movement.

The south-western portion of the State was divided into three areas as shown on the accompanying map.

The restrictions governing the movement of fruit into and out of these areas are outlined below:—

AREA No. 1

Entry of Fruit.—Fruit of any kind from any other part of the State may be sent into Area No. 1, as this is regarded as an area in which the fruit fly is already established.

Fruit Leaving the Area.—Fruit from Area No. 1 may be sent to other places that are within the State, **but outside Areas No. 2 and No. 3.** It is permissible to transport such fruit through Area No. 2 if the most convenient route lies through that area.

Fruit may **NOT** be sent from Area No. 1 to Areas Nos. 2 and 3 except under the conditions detailed in the sections dealing with these areas.

AREA No. 2

Entry of Fruit.—Persons wishing to bring or send fruit into Area No. 2 must make application to a Department of Agriculture inspector and, if required, must furnish particulars concerning:—

(1) The kind and quantity of the fruit.
(2) The place where it was packed.
(3) The places from which and to which it is to be carried.
(4) Method and transportation and route.
(5) Whether the cases or containers are new or secondhand.
(6) The place where the fruit may be inspected prior to transportation.
(7) The periods (if any) during which the fruit was cool-stored.

Subject to the application being approved, fruit may be brought or sent into Area No. 2 from any part of the State except Area No. 1. **Fruit from Area No. 1 must conform to the following regulations:—**

(a) Apples, loquats, apricots, peaches, plums, nectarines, figs, pears, quinces, plantains, pomegranates,

[MAP SHOWING THE THREE AREAS REFERRED TO IN THE REGULATIONS.]

guavas, cumquats, mangoes, tacsonias, persimmons, oranges, mandarins or grapefruit must have been cool-stored at one of the following temperatures and for one of the periods listed:—
31°F. for at least 9 days, or
34°F. for at least 12 days, or
37°F. for at least 16 days.

(b) Lemons, pineapples, bananas and passionfruit must have been examined by an inspector and certified free from fruit fly.

Tomatoes from area No. 1 may be admitted to Area No. 2 without cool storage.

Fruit Leaving the Area.—Fruit from Area No. 2 may be sent to Area No. 1, and to any other place in the State outside Area No. 3. Oranges, mandarins and grapefruit from Area No. 2 may be sent into Area No. 3, between the dates of December 1 and April 30, of any year, but only if they have been examined by an inspector and found to be free from fruit fly.

AREA No. 3

Entry of Fruit.—Persons wishing to bring or send fruit into Area No. 3 must make application to a Department of Agriculture inspector, and, if required, must furnish particulars concerning:—

(1) The kind and quantity of the fruit.

(2) The place where it was packed.

(3) The places from which and to which it is to be carried.

(4) Method and transportation and route.

(5) Whether the cases or containers are new or secondhand.

(6) The place where the fruit may be inspected prior to transportation.

(7) The periods (if any) during which the fruit was cool-stored.

December-April Period. — During the period December 1 to April 30 of any year, no fruit of any kind from any other part of the State may enter Area No. 3 with the exception of:—

(a) Apples, loquats, apricots, peaches, plums, nectarines, figs, pears, quinces, plantains, pomegranates, guavas, cumquats, mangoes, tacsonias, persimmons, oranges, mandarines and grapefruit which have been subjected to cool-storage at a maximum temperature of:—

31°F. for a period of at least 9 days, or

34°F. for a period of at least 12 days, or

37°F. for a period of at least 16 days.

(b) Lemons, grapes, pineapples, bananas and passionfruit which have been examined by an inspector and found to be free from fruit fly.

(c) Tomatoes.

(d) Oranges, mandarins and grapefruit from Area No. 2 which have been examined by an inspector and found to be free from fruit fly.

May-November Period. — During the period May 1 to November 30 of any year, it is permissible to send or bring fruit of any kind into Area No. 3 from any other part of the State **except Area No. 1.** The only fruits allowed to be admitted from Area No. 1 are:—

(a) Apples, loquats, apricots, peaches, plums, nectarines, figs, pears, quinces, plantains, pomegranates, guavas, comquats, mangoes, tacsonias, persimmons, oranges, mandarins or grapefruit which have been subjected to cool-storage at a maximum temperature of:—
31°F. for a period of at least 9 days, or

34°F. for a period of at least 12 days, or

37°F. for a period of at least 16 days.

(b) Lemons, grapes, pineapples, bananas and passionfruit which have been examined by an inspector and found to be free from fruit fly.

(c) Tomatoes.

WINTER COURSES AT MURESK

THREE-DAY courses in Sheep and Wool, Pig Husbandry and Beekeeping will be conducted at Muresk Agricultural College during July. The fee for each course is three guineas, and application forms may be obtained from the Principal, Muresk Agricultural College, and from the Department of Agriculture, St. George's Terrace, Perth.

The Sheep and Wool Course will commence on Tuesday, July 19, at 8 pm., and conclude at 4 p.m. on Friday, July 22.

The Pig Husbandry Course will commence on Tuesday, July 26, at 8 p.m., and conclude at 4 p.m. on Friday, July 29.

The Beekeeping Course will run concurrently with the Pig Husbandry Course (July 26 to 29) if a sufficient number of entries is received.

Students will supply their own sheets, pillowslips, towels and blankets.

The fee of three guineas covers board and lodging at the College during the course, which will consist of practical demonstrations and a series of lecturettes.

Breakfast is at 7.30 a.m., and each day's session commences at 8.15 a.m. There will be evening sessions at which slides will be shown.

FEMALE STUDENTS

Applications will be considered from female students, but they cannot be accommodated at the College for other than meals. If they arrange accommodation in Northam, they will have to supply their own transport to and from the town (9 miles). The fee for female students is two guineas for each course.

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Floribunda Roses

You can make your garden even lovelier with these attractive blooms

By C. C. HILLARY

Fig. 1.—An artistic arrangement of the popular Orange Triumph variety

NO flower has made such a spectacular advance during recent years as the cluster type of rose now classified as Floribunda. Although the earliest kinds were introduced to commerce by the Danish hybridist, S. Poulsen, as Hybrid-polyantha roses as long as 30 years ago, it was not until a few years before World War II that they received much recognition. Then the sterling qualities of roses such as Karen Poulsen and Orange Triumph, for creating massed displays of colour, seemed to be recognised almost overnight and resulted in the planting of many thousands of bushes.

In England, although several kinds, notably Elsie and Kirsten Poulsen, were gradually winning some prominence, it was the brilliant Karen Poulsen that really caught the public eye. I well remember the first beds I saw of this lovely scarlet bedding rose. Situated in Queen Mary's rose garden in Regent's Park, almost in the heart of London, the many hundreds of plants in full bloom held me almost spellbound.

In the same and following years I was to see many more beds of Karen Poulsen. One of the loveliest was in the beautiful gardens of the Birch Hotel, at Hayward's Heath, near the first rose trial ground of the National Rose Society of Great Britain. The beauty of this particular bed was further enhanced by a rising bank of tall, blue and mauve delphiniums which formed the background.

Although some of the Poulsen type of floribunda roses had been grown in Australia for a number of years, it was the arrival of Orange Triumph, a floribunda bred by Herr Kordes, the noted-German hybridist, that made people really sit up and take notice. They liked its colour,

which strangely enough is not orange but a kind of tango-red, its vigorous growth, its free-flowering habit and its great clusters of bloom, and soon it was being planted in thousands. Some grew it in borders, others as a hedge across the front of the garden and others, again, in feature beds in the centre of lawns. The day of the floribunda rose had really arrived.

Fig. 2.—Red Pinocchio

Since the introduction of Karen Poulsen and Orange Triumph, breeders in all parts of the world have vied with one another in the production of new varieties of which there are now many—some will say too many.

The original hybrid-polyantha roses were mostly descendants, on one side at least, of the dwarf polyantha roses and there was some justification for the name. The floribunda roses, however, cannot claim any such relationship, since their ancestry is wide and varied and the sole qualification necessary for inclusion in the group is that the flowers should be freely and constantly produced in panicles or large clusters. The modern floribunda may have large single flowers, like the variety Commonwealth, semi-double flowers of various sizes like the varieties Frensham, Alain and Pinnochio, or small, rosette-type blooms similar to Orange Triumph and Eutin. Almost every colour, except blue, is available and some kinds are sweetly perfumed.

GROWTH IS VIGOROUS

While it can truly be said that all floribundas grow vigorously, they do not all grow into big bushes and their habit of growth varies considerably. The variety Pinkie, for instance, although classified as a floribunda, is a low-growing border rose and rarely grows above 2ft. Within this limit, however, it grows vigorously and is almost always in flower. A dozen bushes grown in a row makes a very charming picture indeed.

On the other hand the deep crimson kind named Frensham grows into a magnificent symmetrical bush about 6ft. high and as much across. It makes a really splendid specimen, or a hedge thick and strong enough almost to keep out goats.

Some like Red Pinnochio and Salmon Perfection, make neat symmetrical bushes about 2½ft. high, and the flowers are borne in clusters more or less evenly all over the plant. Others, such as Alain, Eutin, Crimson Poly and Orange Triumph (to a lesser extent) form comparatively low-growing bushes, but keep sending out great flowering shoots, up to 3ft. in length, above the main body of the plant.

It is generally accepted that the nicest way to grow floribundas is in beds or borders by themselves, with one variety only in each bed. This ensures an evenness of growth and maximum displays of colours throughout the growing season.

There is not the slighest reason, however, why a bed of the coral-coloured Fashion, Red Pinnochio, the cherry-tinted Vogue, or any other kind that fancy may induce you to plant, should not be framed with a border of the low-growing Pinkie. And now that a splendid white in Glacier will be available next year, I think a border of red and white roses planted alternately would provide an arresting and attractive picture.

The soil requirements of floribunda roses are much the same as those necessary for the successful cultivation of

hybrid-tea roses. Heavy or loamy soils must be well drained, cultivated to a depth of 18in., and enriched with old animal manure of some kind, or well-decayed, vegetable compost, plus some blood and bone.

IMPROVING SANDY SOIL

Sandy soils should be strengthened with a proportion of loam and enriched with suitable manures or compost. Good surface loam is the most suitable and it should be mixed with the sand at the rate of one part of loam to two parts of sand. If plenty of loam is available, a fifty-fifty mixture would be even better.

To make a bed in sandy ground, remove the sand to a depth of 2ft. and then place a layer of loam in the bottom of the bed, treading it down until it forms an artificial subsoil 6in. thick. The subsoil will provide a cool resting place for the anchor roots and largely prevent the escape of manures and moisture into the sand below.

Then throw in a quantity of compost, or garden litter in the shape of old leaves, lawn clippings, weeds, etc., together with a dressing of blood and bone. The bed should then be filled to the top with the sand and loam mixture and, during the filling, liberal quantities of old animal manure or well-decayed compost should be worked as evenly as possible through the soil. A good watering should then help to settle the soil and eliminate any air pockets formed during the preparation.

Taken as a class, floribunda roses do not grow quite as big as hybrid-tea roses. When planted in a single row, as in a border bed, they may be spaced a little closer than when a number of bushes are massed in a bed. The border rose Pinkie will be quite happy at 2ft. spacings. Frensham requires at least 4ft. or 5ft. of elbow room, and Alain will probably feel comfortable with 4ft. between the plants. All other varieties should be planted about 3ft. apart.

Light pruning only is necessary. The removal of any dead wood and the spindly and twiggy growths, together with the shortening back about half-way of all flowering stems, is all that need be done at the annual pruning in July. During the flowering season, which is a long one, all faded blooms should be removed with a moderate length of stem regularly.

SOME LOVELY VARIETIES

There are many lovely floribundas and the colours range from white, through various shades of pink, orange and scarlet to the deepest crimson. All of the following are recommended:—

Frensham, the most vigorous-growing floribunda in cultivation and an outstanding sort in every way. It produces attractive crimson roses in large clusters in most prolific fashion for 9 months out of every 12. An excellent sort for a border or a hedge. Height 6ft.

Alain, a glorious deep crimson sort with flowers that often last a fortnight on the plant. The large trusses carry as many as 50 rich, double blooms. Height 4½ft.

Fig. 3.—Karen Poulsen

Commonwealth, a very lovely, sweetly-perfumed variety with large single blooms carried in neat clusters all over the plant. The flowers are deep scarlet, with a pinkish splash in the centre, and last well even in hot weather. Height 3ft.

Salmon Perfection, a semi-double variety in salmon-red with frilled flowers carried in very large clusters. After the style of Orange Triumph, but the blooms are larger and the habit of growth neater. Height 3ft.

Orange Triumph, a very fine floribunda indeed. Grows vigorously and flowers most profusely. The variety which set the fashion in this type of rose. Height 3ft.

Fig. 4.—Else's Rival

Fashion, an outstanding American introduction in a lovely shade of coral-pink, a colour possessed by no other rose. The flowers are semi-double and borne in large clusters. Height 3ft.

Vogue, a full sister to Fashion, but has a more upright habit of growth. Colour is almost cherry-pink and the plants are continuously in flower. In the autumn many of the blooms resemble hybrid-tea roses. Height 4ft.

Masquerade, this is a most remarkable and very lovely rose. Each cluster of 10 to 25 buds produces blooms in yellow, salmon, flame and red and all these colours are present at the same time. Growth is vigorous to 3½ft.

Ma Perkins, a clear pink with double flowers carried in large clusters. The plants are vigorous with attractive bronzy-green foliage. Height 3ft.

Goldilocks, the best of the yellow floribundas and a variety that is nearly always in bloom. The flower clusters are of medium size and the glossy foliage is a pleasing shade of light green. Height 3ft.

Jiminy Cricket, a new variety with large clusters of semi-double flowers in a really lovely shade of orange-salmon. Upright growth and bright, glossy-green foliage. Particularly free flowering. Height 3ft.

Nymph, a fragrant kind in coral-salmon with large trusses of semi-double flowers, one of the loveliest of the latest novelties. Height 3ft.

Glacier, the best white floribunda in existence. The 4in. open flower is very large for this type of rose and lasts unusually well. The bush is branching, vigorous and easy to grow. Height 3ft.

Other fine varieties all of which are well worth growing are Poulsen's Pearl, very pale pink with delightful golden stamens; De Ruiter's "Herald," scarlet-red, shaded orange; Red Pinnochio, crimson; Poulsen's Crimson; Eutin, deep crimson; and Yellow Pinnochio.

Give your roses plenty of water in summer, feed them in February and again in August with a fertiliser mixture composed of equal parts of blood and bone and potato manure (E), place a mulch of old animal manure or compost around them once a year and your plants will return thanks by presenting you with many thousands of flowers.

MINERALS FOR LIVESTOCK

WHY BUY "SHOT-GUN" LICKS?

By L. C. SNOOK, D.Sc., Animal Nutrition Officer

COMMERCIAL stock licks can contain a great variety of minerals, and the labels, as a result, often list an array of ingredients which can appear quite impressive. It is important, therefore, that the farmer should be able to tell which of these ingredients, if any, are of any value to his livestock. In most cases only one or two supplementary minerals are required on a farm, so that if a lick contains a large number of minerals most of these are wasted. For example, in most coastal areas a cobalt supplement is needed by sheep and cattle. The farmer, in this case should buy cobalt and not a compound lick which contains many other things. One does not buy a suite of furniture when all that is required is a chair.

Not only is it necessary to know the constituents which are required by the stock —one should also check on the quantities which are present. Some licks have been described as "phosphatic licks" when they have contained only a little phosphate and a lot of common salt. Considerable quantities of salt are sold at fancy prices in the form of stock licks, so always check the amount of salt which is present before making a purchase And beware of "tricks" of the type employed by the manufacturer of one lick which was advertised as containing 30 per cent. chloride and 45 per cent. sodium when it would have been much simpler (and more honest) to have stated that the lick contained 75 per cent. common salt (sodium chloride).

In order to make the farmer more discriminating when purchasing or preparing stock licks, the following brief comments have been made concerning ingredients which may be included.

COMMON SALT

Common salt is the basis of most mineral licks. It is used because it may be valuable in its own right, but more often because it is a cheap and convenient vehicle through which to feed the so-called trace elements. From time immemorial, salt has been considered necessary to grazing animals, and many farmers still go to considerable expense and trouble to make it available to their stock.

It is now known that sheep, in particular, will eat large quantities of salt, not necessarily because it is of any value to them, but merely because they like salt, just as kiddies like sweets. Quite a few experiments have been carried out in various parts of Australia to determine if common salt is of any value to sheep. In Table I are recorded the results of an experiment carried out in New South Wales (McClymont and Savage, 1950) which shows clearly that sheep can eat considerable quantities of salt without showing any apparent benefit.

TABLE I.

Dorset Horn Weaner Rams	Average Initial Weight	Average Final Weight	Average Gain in 307 days	Lick Eaten
	lb.	lb.	lb.	lb.
Control Group	84	166	82	0
Given Salt Lick	86	168	82	240
Given Salt plus Ground Limestone	86	165	79	396

On the basis of such results, official recommendations have been against the feeding of salt to sheep. The flocks on the research stations in Western Australia do not receive any salt and there is no reason to suspect that the returns have been decreased in any way because of this. It has been argued that salt stimulates the appetite and increases the digestive efficiency of sheep on harsh dry feed. Possibly this is correct but there is no experimental

evidence to justify the feeding of salt to sheep if this is in any way costly or laborious.

At times it is necessary to supply salt to dairy cattle (1 to 2 oz. per head daily) and to pigs (1 lb. in each 200 pounds of grain) but the quantities are relatively small and do not justify the purchase of a large amount of common salt in commercial compound licks. If salt as such is needed, it is cheaper to buy ordinary stock salt and use it according to Departmental recommendations.

CALCIUM OR "LIME" (Ca)

Calcium is a major constituent of bone and it also plays an important part in many bodily processess. Many stockmen still believe that additional lime is needed if animals are to develop sound bone and large frames. In Western Australia, however, most of the pastures supply sufficient lime. Leguminous herbage in particular is rich in lime and where sub-clover, trefoil, lucerne and similar plants are available in reasonable quantity there should be no need to fear a lime deficiency in grazing animals

Cereal grains and cereal hays, in contrast, contain very little calcium. It may be thought, therefore, that calcium supplements would be needed in Eastern Wheatbelt areas where stock have to subsist for many months on a predominantly cereal diet. Fortunately, such does not appear to be the case as no clinical evidence of calcium deficiency has been reported. In fact, sheep from these areas have a reputation for large frames and sound teeth.

Milk fever in cows and hypocalcaemia in sheep occur when the amount of calcium in the blood falls below a critical level. These conditions, however, are not due to a lack of calcium in the diet but to a temporary upset in the mechanism which controls the level of calcium in the blood. As far as we know, the feeding of extra lime will not prevent the occurrence of these diseases.

Calcium deficiency is most likely to be seen in livestock which are kept in a confined area and which receive specialised diets. For example, pigs kept in pens and fed mainly on grain require additional lime (1 per cent. ground limestone in the grain). Laying hens, likewise need plenty of calcium. Where calcium supplements are needed, however, the obvious thing to do is to buy this in the cheapest form, that is, purchase ground limestone or oyster flour and use this as recommended by the Department of Agriculture.

PHOSPHORUS (P)

Phosphorus is needed in considerable amounts by growing and lactating animals and if the diet is deficient in this essential the consequences can be serious. Most soils in Western Australia are deficient in available phosphorus and, even when this has been corrected by continued topdressing, the dry mature herbage available over the summer months rarely contains enough phosphorus for the well-being of grazing animals. In the March-April issue of this Journal methods of supplying phosphorus are described. These recommendations have been reprinted in Bulletin No. 2243 which can be obtained on application.

If a mineral lick is purchased to supply phosphorus care should be taken to ensure that a worthwhile amount of this element is present. I have before me the analyses of one proprietary lick which contains "Phosphorus (P_2O_5)—1.3 per cent." This amount is hardly worth a mention; bran for example, contains more phosphorus than this. When needed, buy a straight out phosphatic supplement such as bonemeal (12 per cent. P = 28 per cent. P_2O_5) or ground rock phosphate (17 per cent. P = 39 per cent. P_2O_5) or use the water soluble fraction in superphosphate.

MAGNESIUM (Mg.)

This is often listed as an ingredient of mineral licks. Plant material contains about 0.5 per cent. Mg. while there is only about 0.04 per cent. in the bodies of animals. Obviously it is most unlikely that grazing animals will need additional magnesium. Magnesium sulphate or Epsom salts can at times serve a useful purpose but it seems pointless to add magnesium to a mineral lick.

POTASSIUM (K)

Plant material is rich in potassium and there is no need to add potash to a mineral lick.

SULPHUR (S)

Elementary sulphur ("flowers of sulphur") has been used in some proprietary licks for many years. Claims are made that this sulphur is of medicinal value and also that it helps in the building up of the sulphur-containing amino acids required for wool growth. There is no evidence, however, that stock on normal rations will benefit from additional sulphur or from sulphates. The dry matter of good pasture should contain about 0.3 per cent. S. It has been shown experimentally that breeding ewes need only 0.1 per cent. S in the dry matter consumed for the efficient production of meat and wool (F. Whiting *et al.* 1954).

IRON (Fe)

Most of us have heard tales concerning the value of iron tonics, and on the strength of these tales, "tonic" mineral licks are sold at a high price. Normal diets contain plenty of iron and it is most unlikely that stock will benefit from any addition. In the past, licks containing "iron" have appeared to be beneficial but this was because the iron salts contained trace elements which were needed. For example, iron ore (limonite) was found to cure Denmark Wasting Disease but this was because limonite contains cobalt: it was lack of cobalt which caused the disease and not lack of iron.

COPPER (Cu)

Copper deficiency was once a serious problem over large areas of Western Australia and stock licks containing copper can be of great value. Copper, however, is an essential plant nutrient and good pasture cannot be grown on copper-deficient soil. It follows that copper where practicable should be used as a fertiliser where the soil is deficient. If the pasture is healthy this will supply all the copper needed by the animal. In pastoral areas and on coastal country where top-dressing would be uneconomic, it may be necessary to use licks containing copper or to add copper to the drinking water. Here again, if copper is needed it seems preferable to buy bluestone as such and use it in one of the ways recommended by Dr. H. W. Bennetts in the January-February issue of the Journal of Agriculture (Bulletin No. 2227). Denmark Lick also, is a cheap and convenient source of copper for livestock.

COBALT (Co)

Generally, in coastal areas cobalt supplements are essential for sheep and cattle. The farmer must decide just how to supply this cobalt. Full details can be obtained in Departmental Bulletin No. 2172. The required cobalt can be supplied at little cost in the form of commercial cobalt salts, or Denmark Lick. Superphosphate containing cobalt can also be applied to the land—cobalt is not a plant food but, if it is present in the soil, sufficient gets into the plant "by accident" to correct cobalt deficiency.

IODINE (I)

In those areas of the world where the soils are deficient in iodine, iodised salt licks have proved of great value. There is no evidence, however, that livestock in Western Australia suffer from lack of iodine. The symptoms seen in iodine deficiency are very characteristic and until these symptoms have been reported and confirmed, there is no point in buying a stock lick because it contains iodine.

MANGANESE (Mn)

Manganese is often listed among the constituents present in stock licks. As far as is known, this is likely to be required only by young chickens on specialised rations. Periodically, reports are received from overseas which suggest that various diseases may result from a lack of manganese. Pending further study, therefore, it would be foolish to dismiss claims that manganese can be beneficial but at present there is little to indicate that additional manganese is needed under field conditions in Western Australia. The requirements of the plant are much greater than those of the animal and therefore stock at pasture do not need supplementation.

ZINC (Zn)

In many areas, crops and pastures have responded to manurial treatment with zinc. This has given rise to the misconception that zinc may be of value to animals also. Even on zinc-deficient soils, the plants contain more than enough zinc for the grazing animals. In other words, although lack of zinc may limit the growth of pasture and the carrying capacity of the farm, such pasture as does grow will contain ample zinc for livestock.

GENERAL

Stock owners in Western Australia are very "mineral conscious." In an endeavour to correct possible deficiencies, there is a tendency to buy small amounts of a lot of things instead of concentrating on known shortcomings. From the comments which have been made in this article it is apparent that the supplementary feeding of minerals can be restricted to two, or perhaps three, constituents. Of course, much remains to be learnt concerning the mineral requirements of animals and it is possible that new knowledge may result in additions to the list of minerals which are required in stock licks. For the present, however, it seems that supplementary feeding can be simple and straightforward. The advocates of compound or "shot-gun" licks claim that it costs very little to put in "everything" so this is done "just in case." The extra ingredients must cost something, however, and when compound licks are used there is a tendency to skimp the main essential. To me it seems preferable to determine what is needed in a given district and to concentrate on supplying this in adequate amounts.

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PARATYPHOID IN SHEEP

By C. R. TOOP, B.V.Sc., Chief Veterinary Surgeon

UNTIL quite recently, paratyphoid had not been diagnosed in sheep in Western Australia, other than in imported Eastern States rams which had developed the disease as a sequel to the conditions to which they had been exposed in transit.

During the past three summers, however, a number of outbreaks have been reported in flock sheep in the agricultural areas and in some of these the losses have been serious. Earlier outbreaks may of course have occurred but because the symptoms are in some respects similar it is possible that the disease was mistaken for enterotoxaemia.

Three mortalities with symptoms of lethargy and scouring were reported from the Geraldton district in January and a diagnosis of paratyphoid was established by the bacteriological examination of specimens forwarded to the Departments Animal Health and Nutrition Laboratory at Perth.

Paratyphoid is caused by microbes of the salmonella group, about 180 species of which are known to exist, and animals become affected by the disease from the consumption of food or water contaminated by these organisms. It is a very common and serious disease of pigs and it also affects sheep, cattle, horses, ducks and poultry.

Affected sheep show symptoms of fever and rapid respiration. They become dull and listless and cease to feed and spend much of their time lying down. When standing the back is arched and the feet are drawn up under the body and there is evidence of abdominal pain. Scouring accompanied by the passage of foul-smelling liquid droppings is a prominent feature of the disease. Many affected sheep die within 24 hours of the onset of symptoms but some may linger for several days and those less severely affected may recover.

At post-mortem examination, inflammatory changes denoted by reddening of the lining membrane will usually be found in the stomach and intestines, and the associated lymph nodes are swollen and congested.

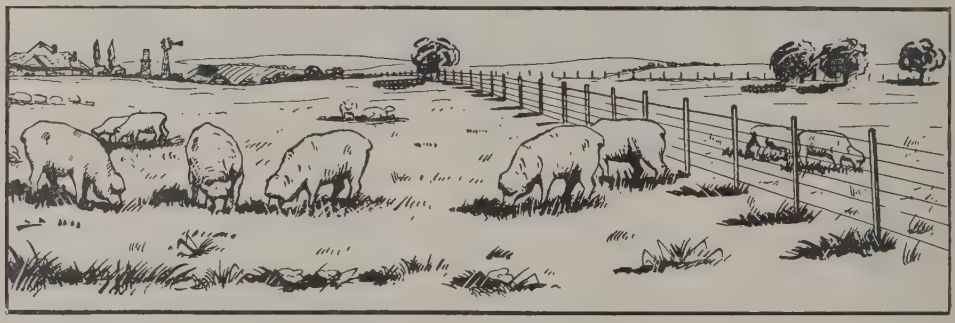
There are no vaccines available for the immunisation of sheep against paratyphoid and to prevent losses from the disease it is necessary to rely on hygienic precautions and these must be directed against the consumption of contaminated food and water. The flock should be provided with a clean and wholesome water supply, and small stagnant dams and soaks which may have become polluted with manure must at all costs be avoided. Chaff or grain which has been heavily infested with mice should not be used and, where supplementary feeding is practised, the grain should be distributed on clean ground on each occasion.

When an outbreak of paratyphoid is in progress, affected sheep which are passing out the infective organisms in their droppings in enormous numbers should be isolated without delay and the flock trans-

ferred to a fresh paddock. This procedure should be continued so long as fresh cases continue to occur.

Under the hot, dry conditions of summer the infection is able to survive in the soil only for a short period so the control of the disease should not present a difficult problem.

For the treatment of affected sheep the injection of 33⅓ per cent. sodium sulphamezathine in a dosage of 20 ccs. on the first day followed by 15 ccs., daily for the next four days is recommended. The results, however, are variable and while some animals may recover there will be no response in others.



MODERN METHODS OF APPLYING INSECTICIDES

By P. N. FORTE, B.Sc. (Agric.), Senior Entomologist

ALMOST everyone appreciates the fact that the successful control of some insects has been accomplished on a grand scale. They will remember the spectacular control of mosquitoes using DDT during the war, and some would remember its use to control other pests such as lice. However, I think relatively few appreciate the vast areas which have been covered with DDT and other new insecticides such as chlordane and dieldrin in the campaign against insect pests attacking farm crops and animals.

How has this been accomplished? Firstly, new insecticides have been found which will kill insects at a very small dosage per acre, e.g., dieldrin at 2 oz. to the acre for grasshopper control. Secondly, mechanical distribution of insecticides has been perfected to the stage where this small quantity per acre can be applied to give an efficient cover with a proportionately small amount of carrier.

It is not very long ago that in any spraying operations it was deemed necessary to apply 100 gallons of spray per acre to get a sufficiently effective cover to protect a crop from insect pest attack. Similarly, 30 lb. of dust per acre was considered the requirement for dusting crops. This was quite satisfactory and necessary when insecticides such as arsenate of lead were in use. When new insecticides such as DDT and dieldrin were developed, such a small quantity per acre was required that if it was applied at 30 lb. per acre as a dust it was wasteful. Therefore it was desirable that equipment should be developed to apply smaller quantities of insecticides per acre and still obtain an effective cover. This was most necessary where large areas were to be treated. We can trace then a transition from the knapsack and rotary hand dusters applying 30 lb. of dust per acre to efficient power dusters which,

mounted on motor vehicles, were capable of covering acres per day with an application rate as low as 10 lb. per acre.

It was these power dusters and DDT that solved the climbing cutworm problem which menaced flax and linseed growing in this State during and since the war.

Finally, aircraft were tried and found quite satisfactory for dusting crops.

Aircraft have the added advantage of being able to treat large areas quickly at the right time for pest control without damage to the crop and possibly at a time when ground vehicles could not be used.

However, dusts are generally more wasteful of insecticides than sprays.

The most successful attempt to reduce the volume of spray per acre and still get efficient coverage was the low volume boom spray. With this equipment it is possible to apply as low as five gallons of spray per acre and get an efficient cover. This development was a considerable step forward, and thousands of acres have been treated by this method to control pasture and crop insect pests.

The next and greatest step forward was the successful development of low-flying aircraft to distribute insecticides. Careful tests have shown that an excellent distribution could be obtained with as low as 1½ to 2 gallons per acre. What does this mean to the individual requiring pest control? It means that whereas 10 or 15 years ago it was almost impossible to control insect plagues on a large area, now it can be done efficiently and quickly over thousands of acres.

Similarly, in orchards, spray machines have been developed to give a more effective cover and yet reduce the time of application and the manpower required.

Even in a brief resume of the subject of this talk one cannot leave out mention of the development of methods of applying insecticides for the control of household pests in dwellings.

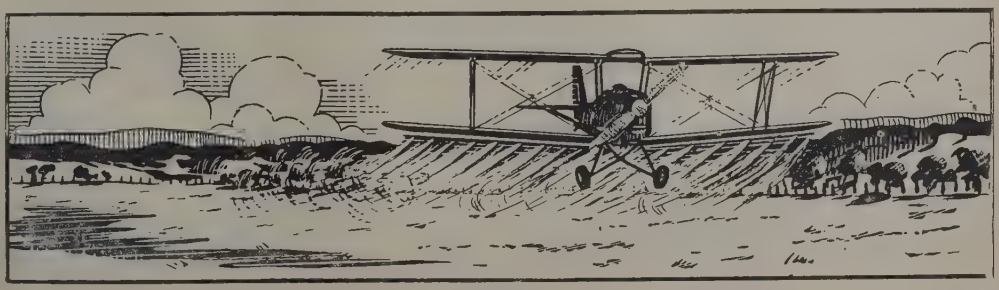
Everyone is familiar with the atomiser used for dispersing fly sprays, and some of you will remember the influence this mechanical means of application had in popularising the sprays which were so useful in controlling flies, etc., in houses.

An equally revolutionary method of dispersing insecticides for household pest control was developed in the United States of America just before the war, was used by the armed forces during the war, and has recently appeared on the Australian market in an improved form. The insecticide container is known as an aerosol bomb.

In this method the insecticides are dissolved in a solvent under pressure and placed in suitable containers. By releasing a stopper at one end the liquid is released through a small aperture and a fine spray or mist is developed. The solvent evaporates immediately and the small particles of the insecticide are left suspended in the air where they float and gradually settle. It is almost impossible for any flying insect to escape these particles and fail to receive a lethal dose.

With better insecticides than DDT available, these bombs are now available to householders and their efficiency for killing household insects is so remarkable that it needs to be seen to be appreciated.

However, it is up to the individual to see that the correct insecticides are used and thoroughly applied, and when in doubt information can be obtained from the Department of Agriculture.



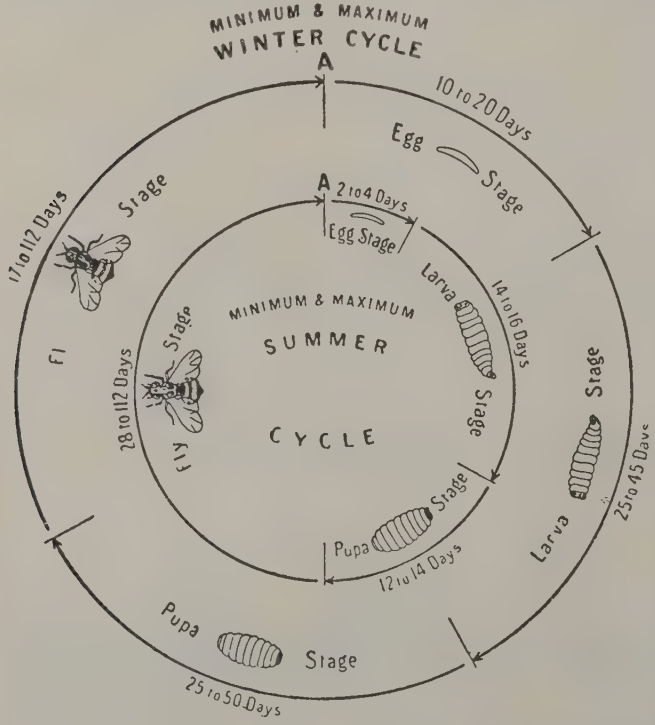
FRUIT FLY

By C. F. H. JENKINS, M.A., Government Entomologist

DO you like growing fruit for someone else to steal? That may sound rather a silly question and yet it is rather surprising the number of people who take considerable trouble to plant, water and prune fruit trees and then allow another to reap the harvest. This is not consciously permitted, of course. They always hope to pick the fruit and they may even do so. But how often does a luscious pear or a ripe fig turn out to be crawling with maggots? Not a very nice subject. But one which cannot be bypassed on that account, as fruit fly maggots are costing Western Australian fruit growers thousands of pounds annually, and if considered on a Commonwealth basis, the losses may reach millions.

How is it that this serious pest is allowed to decimate our orchards and to imperil the very existence of certain branches of the fruit industry? The pest can certainly be controlled if all the known control measures are conscientiously applied. But fruit is so widely grown that it has so far proved impossible to get everyone to treat their trees with the necessary attention to detail.

Many will think that a talk about fruit fly at the end of autumn is quite out of season. It is popular to regard the fruit fly as a spring and summer pest and to heave a sigh of relief as the baiting material is put away in the autumn. The fruit fly is always with us and must be fought all the year round. The heaviest losses occur in the spring and summer because most of the stone fruits ripen in that period.



The life-cycle of the Mediterranean Fruit Fly in Western Australia.
[After Newman.]

Pears, apples and citrus, however, carry the pest through the autumn and winter and, although fly numbers are very low in the cooler months, it is these few survivors which start off the next season's plagues.

Poison baiting with sodium fluosilicate and sugar is still the recommended control for fruit fly. Many people wonder why the newer insecticides have not been substituted. Tests have shown several of them to be very toxic to the fruit fly but none has proved superior to sodium fluosilicate which has been in use in Western Australia for nearly 20 years.

The regular picking up and disposal of infested fruits is just as important as chemical baiting and, if these two methods were universally applied, our fruit fly problem would disappear.

Most commercial growers realise the danger of fruit fly attack and carry out regular control measures. Backyard growers and those with week-end cottages are often serious delinquents, however, and as a result of their neglect, many suffer. The adoption of community baiting in certain areas has demonstrated clearly the efficiency of the present control measures. Where regular wholesale baiting has been carried out, a marked improvement in the local fruit fly position has resulted and points the moral that it is the few negligent people who undermine the whole.

Fruit fly research is being intensified in several Australian States due to the gradual spread of the Queensland fruit fly, a species which fortunately is not known in this State. Further work is also being continued on the Mediterranean species which is the local variety and one with a world wide and really infamous reputation.

Fruit fumigation techniques are being developed which will kill the eggs and young maggots before any damage is done and also enable export lines to comply with the quarantine requirements of certain importing countries.

New and more effective baits and perhaps soil treatments will undoubtedly be developed in the future for fruit fly control. But at the present time the universal adoption of old but well-tried methods is the surest way of combating a pest which takes far too heavy a toll of the annual fruit crop.

CURRENT COMMENTS ON VERMIN CONTROL

By A. R. TOMLINSON, Chief Vermin Control Officer

PERHAPS the most interesting recent developments in regard to vermin control are the outbreaks of myxomatosis which were reported earlier in the year. The main series extended over an area at least 60 miles long by 30 miles wide covering sections of the Toodyay, Northam, York and Beverley districts. Within this area small outbreaks occurred before Christmas, and flared up after the February floods.

Reports of outbreaks at many other places have been received including the Peel Inlet west of Pinjarra south of Mandurah, Williams, the Geraldton region, Katanning and Narrogin.

The disease has taken the pattern which had been anticipated and, following the recent rains, further spreads are expected.

Our spreads have not been as spectacular as those in the Eastern States, but there can be little doubt that hundreds of thousands of rabbits have been killed and agricultural production greatly increased.

Many of the outbreaks have originated from the work of the Agriculture Protection Board officers, but Vermin Boards and farmers who have persisted in endeavouring to establish the disease are to be praised for their efforts.

It is not too late to establish the disease and farmers would be well advised to carry out inoculation, particularly where mosquitoes are noticed to be plentiful in paddocks or the bush.

The "1080" rabbit control scheme is atracting much attention. This relatively new poison—"1080"—is being used in a large field trial in the Manjimup area, and has proved very successful. Farmers generally have expressed great satisfaction with the results, and are to be congratulated on the co-operation they have given.

In the scheme, farmers "free feed" with unpoisoned bait for three nights. On the fourth night bait is poisoned with "1080" and distributed by trained Agriculture Protection Board officers. A charge is made for the services of our men and the amount of poison used.

The experience gained to date has indicated that the reasons for the outstanding success may be placed in the following order:—

(1) The farmers are doing a praiseworthy job in the "free feeding."
(2) The work is conducted on a front so that all properties are being treated.
(3) "1080" is more effective than other poisons.

It will be noted that the effectiveness of "1080" is placed last, as without the efficient free feeding and the co-ordinated drive most of the advantage would be lost.

The Public Health Department will not permit "1080" to be used by anyone other than trained Agriculture Protection Board officers, but the Board intends to extend its scheme next season, to as much of the Lower South-West and Lower Great Southern as its organisation can include.

The decision of the Agriculture Protection Board to substitute the supply of free spraying materials for bran bait is of great importance to the grasshopper-infested areas.

Breaking up of the egg-beds is still considered the most effective control measure, and the ploughing subsidy will be continued.

Tests conducted here by the Entomological Branch of the Department of Agriculture and experience elsewhere have indicated that spraying with dieldrin is more effective than bran baiting with benzene hexachloride.

In the new scheme, spray will be distributed free to farmers who have satisfactory low-volume spraying implements. For farmers without the necessary equipment, Agriculture Protection Board units will be available to carry out the spraying at a charge to cover the cost of the units. No charge will be made for the dieldrin.

In this first season it is expected that organisational problems will prevent the operations of the units from being extended to the northern agricultural areas where free baiting material will again be made available. Farmers with suitable spraying equipment in these areas will be able to obtain free dieldrin.

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SUNRISE AND SUNSET TIMES FOR MAY-JUNE, 1955

(Supplied by the Government Astronomer)

Times of sunrise and sunset for every fifth day, are given for a number of towns throughout the State. Times for a town not on the list may be estimated if its position in relation to one or more of the listed towns is known. The times given for sunrise are those of the first appearance of the top edge of the sun over a true horizon; those for sunset give the time of the sun's disappearance below a true horizon. Situation in a valley would make the sun appear to rise later, and on a hill it would appear earlier.

SUNRISE

Month.	Day of Month	Broome.	Port Hedland.	Onslow.	Carnarvon.	Yalgoo.	Geraldton.	Moora.	Kalgoorlie.	Southern Cross.	Merredin.	Perth.	Tammin.	Northam.	Narrogin.	Collie.	Bunbury.	Katanning.	Bridgetown.	Hopetoun.	Esperance.	Cape Leeuwin	Albany.
July	1	6·23	6·42	7·0	7·11	7·6	7·17	7·15	6·53	7·2	7·6	7·19	7·12	7·15	7·15	7·20	7·22	7·17	7·22	7·7	7·0	7·27	7·17
,, ...	5	6·23	6·42	7·0	7·11	7·5	7·16	7·14	6·52	7·1	7·5	7·18	7·11	7·14	7·14	7·19	7·21	7·16	7·21	7·6	6·59	7·26	7·16
,, ...	10	6·23	6·41	6·59	7·10	7·4	7·15	7·13	6·51	7·0	7·4	7·17	7·10	7·13	7·13	7·18	7·20	7·15	7·20	7·5	6·58	7·25	7·15
,, ...	15	6·23	6·41	6·59	7·10	7·3	7·14	7·12	6·50	6·59	7·3	7·15	7·8	7·11	7·12	7·17	7·19	7·13	7·18	7·3	6·56	7·23	7·13
,, ...	20	6·22	6·40	6·58	7·9	7·2	7·13	7·11	6·49	6·58	7·2	7·14	7·7	7·10	7·11	7·16	7·18	7·12	7·17	7·2	6·55	7·22	7·12
,, ...	25	6·21	6·39	6·57	7·7	7·0	7·11	7·9	6·47	6·56	7·0	7·12	7·5	7·8	7·8	7·13	7·15	7·9	7·14	6·59	6·52	7·19	7·9
,, ...	31	6·18	6·36	6·53	7·3	6·56	7·6	7·4	6·42	6·51	6·55	7·7	7·0	7·3	7·2	7·7	7·9	7·3	7·8	6·53	6·46	7·13	7·3
Aug....	1	6·18	6·36	6·53	7·3	6·56	7·6	7·4	6·42	6·51	6·55	7·7	7·0	7·3	7·2	7·7	7·9	7·3	7·8	6·53	6·46	7·13	7·3
,, ...	5	6·16	6·34	6·51	7·0	6·53	7·3	7·1	6·39	6·48	6·52	7·4	6·57	7·0	6·59	7·4	7·6	7·0	7·5	6·50	6·43	7·10	7·0
,, ...	10	6·14	6·31	6·48	6·57	6·49	7·0	6·57	6·35	6·44	6·48	6·59	6·52	6·55	6·55	7·0	7·2	6·55	7·0	6·45	6·38	7·5	6·55
,, ...	15	6·11	6·28	6·44	6·53	6·45	6·55	6·51	6·29	6·38	6·42	6·54	6·47	6·50	6·49	6·54	6·56	6·50	6·55	6·40	6·33	7·0	6·49
,, ...	20	6·7	6·24	6·40	6·48	6·40	6·50	6·46	6·24	6·33	6·37	6·48	6·41	6·44	6·44	6·49	6·51	6·44	6·49	6·34	6·27	6·54	6·43
,, ...	25	6·4	6·21	6·37	6·44	6·35	6·45	6·41	6·19	6·28	6·32	6·43	6·36	6·39	6·39	6·44	6·46	6·39	6·44	6·29	6·22	6·49	6·38
,, ...	31	6·0	6·16	6·31	6·38	6·29	6·38	6·34	6·12	6·21	6·25	6·36	6·29	6·32	6·31	6·36	6·38	6·31	6·36	6·21	6·14	6·41	6·30

SUNSET

Month.	Day of Month	Broome.	Port Hedland.	Onslow.	Carnarvon.	Yalgoo.	Geraldton.	Moora.	Kalgoorlie.	Southern Cross.	Merredin.	Perth.	Tammin.	Northam.	Narrogin.	Collie.	Bunbury.	Katanning.	Bridgetown.	Hopetoun.	Esperance.	Cape Leeuwin	Albany.
July	1	5·27	5·38	5·48	5·47	5·28	5·35	5·25	5·3	5·12	5·16	5·23	5·16	5·19	5·15	5·20	5·22	5·11	5·16	5·1	4·54	5·21	5·7
,, ...	5	5·28	5·39	5·49	5·48	5·29	5·36	5·26	5·4	5·13	5·17	5·24	5·17	5·20	5·16	5·21	5·23	5·12	5·17	5·2	4·55	5·22	5·8
,, ...	10	5·29	5·40	5·50	5·49	5·31	5·38	5·28	5·6	5·15	5·19	5·27	5·20	5·23	5·18	5·23	5·25	5·14	5·19	5·4	4·57	5·24	5·10
,, ...	15	5·30	5·42	5·52	5·51	5·34	5·41	5·31	5·9	5·18	5·22	5·30	5·23	5·26	5·21	5·26	5·28	5·18	5·23	5·8	5·1	5·28	5·14
,, ...	20	5·32	5·44	5·56	5·54	5·37	5·44	5·34	5·12	5·21	5·25	5·33	5·26	5·29	5·24	5·29	5·31	5·21	5·26	5·11	5·4	5·31	5·17
,, ...	25	5·34	5·46	5·57	5·56	5·39	5·47	5·37	5·15	5·24	5·28	5·36	5·29	5·32	5·28	5·33	5·35	5·25	5·30	5·15	5·8	5·35	5·21
,, ...	31	5·36	5·48	5·59	5·59	5·42	5·50	5·40	5·18	5·27	5·31	5·39	5·32	5·35	5·32	5·37	5·39	5·29	5·34	5·19	5·12	5·39	5·25
Aug....	1	5·37	5·49	6·0	6·0	5·43	5·51	5·41	5·19	5·28	5·32	5·40	5·33	5·36	5·33	5·38	5·40	5·30	5·35	5·20	5·13	5·40	5·26
,, ...	5	5·38	5·50	6·1	6·1	5·44	5·52	5·42	5·20	5·29	5·33	5·42	5·35	5·38	5·34	5·39	5·41	5·32	5·37	5·22	5·15	5·42	5·28
,, ...	10	5·38	5·51	6·2	6·4	5·48	5·55	5·46	5·24	5·33	5·37	5·46	5·39	5·42	5·38	5·43	5·45	5·36	5·41	5·26	5·19	5·46	5·32
,, ...	15	5·40	5·53	6·5	6·6	5·50	5·58	5·50	5·28	5·37	5·41	5·49	5·42	5·45	5·42	5·47	5·49	5·39	5·44	5·29	5·22	5·49	5·36
,, ...	20	5·41	5·54	6·6	6·8	5·53	6·1	5·53	5·31	5·40	5·44	5·53	5·46	5·49	5·45	5·50	5·52	5·43	5·48	5·33	5·26	5·53	5·40
,, ...	25	5·42	5·55	6·7	6·10	5·55	6·3	5·55	5·33	5·42	5·46	5·55	5·48	5·51	5·48	5·53	5·55	5·46	5·51	5·36	5·29	5·56	5·43
,, ...	31	5·43	5·57	6·9	6·12	5·58	6·6	5·58	5·36	5·45	5·49	5·58	5·51	5·54	5·52	5·57	5·59	5·50	5·55	5·40	5·33	6·0	5·47